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Management of FX settlement risk in Hungary (Report II)

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Management of FX settlement risk in Hungary (Report II)

(Payments and Securities Settlements)

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1. Foreword

The concept known as FX settlement risk (aka Herstatt risk) came into focus some thirty years ago when Bankhaus Herstatt, a small German bank, became insolvent leaving its counterparties with credit exposure equivalent to the nominal value of receivables in US dollar from FX transactions, for which they had already transferred their payables in Deutsch mark to the failed bank. There was no way to withdraw their payment orders. These events, however, shed some light on the – usually significant – risks inherent in clearing and settlement procedures of financial transactions. Under the aegis of the Bank for International Settlements (BIS), central banks set out in 1996 to take joint action and find a solution for this matter. They consequently came up with a methodology, which is now broadly used by a great many central banks for mapping and measuring FX settlement risk.

The MNB undertook an analysis among banks active on the FX markets with questionnaires following the BIS methodology and personal interviews for the first time in October 2000, and published the results and observations in 2001 (MNB, 2001) under the title 'Management of FX settlement risk in Hungary'. As the FX trading data indicated significant risks faced by the Hungarian banking system in terms of FX settlement, in 2005 the MNB decided to revisit the same area and conduct a survey similar to the review completed in 2000. The MNB received a significant boost in its efforts early in 2006 when BIS announced its intention to conduct a survey of the subject once again among the G10 central banks.[1]

The objective of this study is to analyse – relying on 2006 data – FX settlement risk that may arise in the domestic banking system under its current operations, and to chart the changes which took place after 2000, covering improvements and, if necessary, formulating (new) recommendations to reduce risks. As will be referred to in many cases, this study actively relies on the material published in 2000, including the methodology it describes in detail. As a number of central banks (for example Riksbank and Norges Bank) are using the BIS methodology plus other (regular and specific) statistical reports to analyse FX settlement risk in the credit institution sector, along with all its consequences for financial stability, this latest analysis involves a deeper approach, reaching somewhat beyond the constraints of the 2000 publication. In the first chapter we will demonstrate how FX settlement risk is treated among other risks to which banks are exposed, including its dimensions and the impact it may have on financial stability, and the means available to reduce risks in general. The second chapter contains a brief description of the 2006 survey and a summary of general views and overall concepts relating to the information obtained through the questionnaires and personal interviews. The third chapter provides an analysis of the data conveyed in the 2006 survey and – minus the composition effect – a comparison of the results from 2000 and 2006. The fourth chapter offers an overview of the personal interviews, and at the end a summary of the results, conclusions and recommendations for future purposes, where deemed necessary.

JEL: F31, G21, G32.
Keywords: FX settlement riks, Continuous Linked Settlement, CLS, payment system, settlement limit, risk management.

[1] We wish to express our gratitude to colleagues at BIS for allowing use of the questionnaire they prepared, since it provided a solid base for us to conduct our own survey among Hungarian banks. We would also like to thank these banks for their participation in the survey, helping our work by completing the questionnaires and through personal consultation. On behalf of MNB the survey and interviews were conducted by Cecília Pintér and Eszter Tanai (Payment Systems and Currency Issue Policy), and Andrea Havas, Erik Horgász, Sándor Valkovszky and Péter Vereszki (Market Risk Management).

1. Bevezetés

A devizakiegyenlítési (más néven Herstatt) kockázat több mint 30 évvel ezelőtt került az érdeklődés középpontjába, amikor egy kis mérlegfőösszegű német bank (Bankhaus Herstatt) fizetésképtelensége miatt a hitelintézet devizapiaci partnerei nem jutottak hozzá az általuk vásárolt devizához, holott az ügylet ellenértékét már korábban elutalták a csődbe ment banknak. Az általuk elküldött fizetési megbízásokat visszavonni már nem lehetett. A történtek felhívták a figyelmet a pénzügyi tranzakciók elszámolási és kiegyenlítési folyamatában rejlő, sokszor jelentős kockázatokra. A jegybankok a Bank for International Settlements (BIS) égisze alatt 1996-ban kezdtek el közösen foglalkozni a kérdéssel és alakították ki azt a mérési módszertant, amelyet ma már számos központi bank alkalmaz a kockázatok feltérképezésére.

Az MNB 2000 októberében végezte el először a BIS-módszertant alkalmazó kérdőíveken, illetve személyes megbeszéléseken alapuló elemzést a devizapiacon aktív bankok körében. A 2000-es eredményeket és tapasztalatokat az MNB 2001-ben publikálta (MNB, 2001) „A devizaügyletek kiegyenlítési kockázatának kezelése Magyarországon" címmel. Mivel a devizakereskedési adatok arra utaltak, hogy a devizakiegyenlítés terén jelentős kockázatokkal szembesül a hazai bankrendszer, az MNB 2005-ben elhatározta, hogy a 2000-es felméréshez hasonlóan újra feltérképezi ezt a területet. Az MNB munkáját nagyban megkönnyítette, hogy 2006 elején a BIS bejelentette, hogy a G10 jegybankok közreműködésével ismét elkészíti felmérését e témában.[1]

Jelen tanulmány célja, hogy 2006-os adatok alapján elemezze a bankrendszer jelenlegi tevékenysége melletti devizakiegyenlítési kockázatot, valamint feltérképezze a 2000. évi elemzés óta bekövetkezett változásokat, fejlődést, illetve amennyiben szükséges, a kockázatok csökkentése érdekében (újabb) ajánlásokat fogalmazzon meg. Ahogy számos esetben referencia mutatja majd, a tanulmány aktívan épít a 2000. évi kiadványban leírtakra, így az ott már részletesen bemutatott mérési módszertanra is. Mivel számos jegybank (például a Riksbank vagy a Norges Bank) a BIS-módszertan alapján végzett felmérésen túl (rendszeres vagy egyedi) adatszolgáltatás segítségével elemzi a hitelintézeti szektorban jelentkező devizakiegyenlítési kockázatot és annak pénzügyi stabilitási vonatkozásait, ezért a mostani elemzés a 2000. évi kiadványon némileg túllépve, messzebbről közelíti meg a témát. Az első részben bemutatjuk, hogy miképpen illeszkedik a devizakiegyenlítési kockázat a bankok által viselt kockázatok körébe, milyen dimenziók jellemzik, hogyan hathat a pénzügyi stabilitásra és mely eszközökkel lehetséges a kockázat csökkentése. A második részben a 2006-os felmérés rövid bemutatására, a kérdőívekkel és személyes interjúkkal nyert adatokkal kapcsolatos általános megfontolások ismertetésére kerül sor. A harmadik rész a 2006-os felméréssel nyert adatok elemzését, illetve az összetételhatás kiszűrésével a 2000-es és 2006-os eredmények összehasonlítását tartalmazza. A negyedik részben sommásan kitérünk a személyes interjúk tapasztalataira, végül összefoglaljuk az eredményeket, levonjuk a következtetéseket és szükség esetén megfogalmazzuk a jövőbeni teendőket.

JEL: F31, G21, G32.
Kulcsszavak: devizakiegyenlítési kockázat, Continuous Linked Settlement, CLS, fizetési rendszer, settlement limit, kockáztkezelés.

[1] Köszönettel tartozunk a BIS munkatársainak, amiért az általuk készített kérdőívet a rendelkezésünkre bocsátották, amely hasznos alapjául szolgált a hazai bankok körében végzett felmérésnek. Köszönet illeti a felmérésben részt vevő hazai bankokat, akik a kérdőív kitöltésével, valamint személyes konzultációval segítették a munkánkat. Az MNB részéről a kérdőívezésben és az interjúkon részt vevő munkatársak Pintér Cecília és Tanai Eszter (Pénzforgalom és emissziószervezés), valamint Havas Andrea, Horgász Erik, Valkovszky Sándor és Vereszki Péter (Piaci kockázatkezelés) voltak.

2. The FX settlement risk among other bank exposures

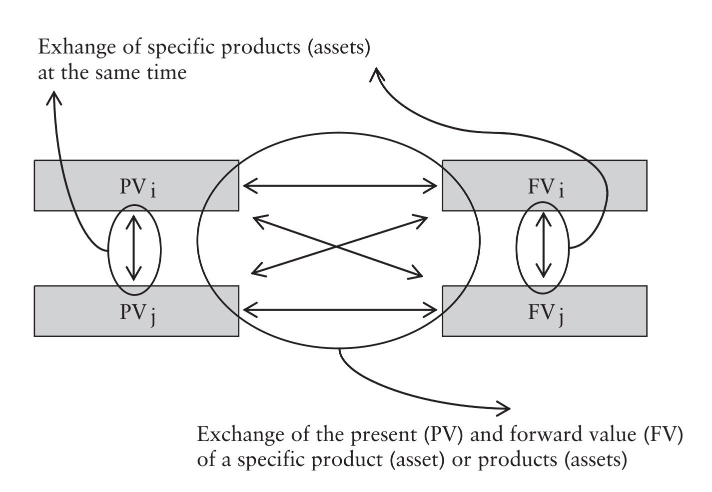
2.1. RISKS OFF THE BANK BALANCE SHEETS, SETTLEMENT RISK

The business operations of credit institutions can carry different types of risks, some of which are the result of taking positions with a view to future earnings (i.e. counterparty risk, market risk), while others are the by-product of settling (real economy and/or financial) transactions (settlement risk) which are arranged to take or to lessen risk borne by the credit institution (for example, in connection with FX transactions *correspondent bank risk*[2] *and settlement risk are of particular importance).* While credit institutions undertake the former consciously, usually they are 'forced' to bear the latter if they wish to conclude certain types of transactions. Of course, concerning settlement risk they could have the possibility of choice, provided there are several correspondent banks and settlement methods available on the market. In this case credit institutions can pick the preferred option based on the costs and benefits. On the other hand, a solution considered rational at the bank level may not coincide with the financial system optimum, as credit institutions can tend to overlook factors deemed important from the perspective of financial stability.

The settlement risk in general means that the clearing and settlement arrangements do not guarantee for a particular bank that the completion of the sale side of its transaction should be effected only if the asset (which could be domestic or foreign currency, securities, etc.) purchased by it has been delivered. Settlement risk typically occurs (Chart 1) if the bank rearranges (will rearrange) the asset side of its balance sheet, and the transaction entails the simultaneous exchange of the assets (this exchange could happen in the present or in the future). Additionally, settlement risk may also arise in connection with special transactions (mostly concluded in order to reduce underlying risk, for example, covered transactions, such as repurchase agreements), stemming from the exchange of the present and future value of a certain asset or assets.

Chart 1

Model of transactions for restructuring the asset side of the balance sheet of banks



PV = present value, FV = future value, i and j indices indicate non-specific instruments/assets.

If the underlying assets are various currencies, there is an FX settlement risk (aka Herstatt risk). Included in this category are spot and forward FX transactions, FX swaps and exercised FX options. Since settlement risk originates from the uncoordinated delivery of two valuable assets, clearing and settlement methods devised to eliminate settlement risk by

[2] In the event that the correspondent bank goes bankrupt, protection for the client transactions already performed by the correspondent bank (and shown on the debit side) is available in a host of countries throughout Europe in connection with the systems designated for the implementation of the directive concerning the finality of settlements made through payment and securities clearing systems.

arranging the delivery of the two legs of the transaction simultaneously appear to offer a solution to both parties, as they follow the principle of Payment versus Payment, (hereinafter 'PvP principle'), or Delivery versus Payment in the case of securities (hereinafter 'DvP principle') and Delivery versus Delivery (hereinafter 'DvD principle').

Some counterparty exposures of financial transactions and the settlement risk cannot be assessed by analysing bank balance sheets (or off balance sheet items where applicable). In many cases, the duration of these risks is very short, while the size of exposure changes rapidly; hence significant risks can accumulate quickly in the financial sector without even appearing in the balance sheets. When the degree of concentration of exposures is high, or in the event of a general crisis, the crystallisation of these risks could result in considerable (solvency) problems in the banking sector. Stemming from the rapid fluctuation of risk exposures, if the central bank were to rely only on periodic data of the bank balance sheets in its financial stability analysis, it could encounter loss of information, which in turn could result in some risks being left unidentified.

According to our observations, many central banks collect data in order to identify risks which do not appear in the banks' balance sheets (off balance sheet risks). The information received through regular and ad hoc reports, however, is not always analysed in-depth as far as credit risk is concerned, or the analysis is not conducted regularly. The contagion effect of uncovered interbank transactions is examined most often, including one completed in Hungary (Lublóy, 2004). The central bank of Sweden uses a relatively integrated approach built gradually on regular data reporting (Riksbank, 1998a; 1998b; 1999; 2000; 2002; 2005a; 2005b; 2006), that has become an important part of its stability report since 1998 (see Box 1). Riksbank managed to determine in the Swedish banking sector the sources of short-term credit risks (including FX settlement risk) and requires quarterly data reporting for the purpose of examining contagion (Riksbank, 2002; 2005a; 2005b; 2006). Norges Bank followed suite and prepared its own analysis using the Swedish example (Norges Bank, 2003).

Box 1: Theoretical framework developed by the Riksbank for analysing settlement and counterparty risk exposures

The theoretical framework developed by Riksbank in 1998 recognises five different types of risk relating to *settlement and counterparty risk* in connection with financial transactions:

1. exposures from unsecured interbank lending,
2. exposures to issuers of securities held in portfolio,
3. derivative exposures,
4. exposures from interbank repurchase agreements (or other secured lending), and
5. FX settlement risk exposures.

In connection with the above exposures the Swedish central bank requires quarterly data reports, taking into consideration the legally enforceable netting arrangements. The reporting requirements have gone through several levels of fine-tuning in order to better identify the actual risk exposures in the Swedish banking system. For example, they removed government papers and securities of similar credit risk classification from the category of own securities, then after the introduction of SEK into CLS the report became more detailed, so as to take into account the risk reduction due to settlement via CLS. Norges Bank asked for reporting similar to the one described above, adding the securities of own issue held by the reporting counterparty guarantees and unutilised credit lines. Riksbank conducted its analysis of contagion relating to the above-specified risk categories based on quarterly reports, while Norges Bank used specific reports for the same purpose.

The surveys have shown that (until the introduction of CLS at the least) FX settlement risk represented the highest percentage among all risk types (several times depending on the date of data reporting), and that it sometimes exceeded the primary capital of reporting counterparties many times over. Consequently, the impact of the contagion considering FX settlement risk as well was significantly more drastic compared to the one without it. The evolution of this risk shows a great deal of volatility, depending largely on developments in the foreign exchange markets. Regarding the foreign exchange transactions in question, international financial institutions had been the major counterparties of the reporting institutions. The concentration of FX settlement risk was significant.

Of course, the transactions to be included in the reporting and in the analysis of contagion differ for every country. It depends primarily on the most popular instruments of the financial markets, and on settlement methods applied. However, data from the most recent periods indicate that foreign exchange markets in Hungary show a great deal of activity, as in Sweden and Norway, and they carry some similar features. Thus this area deserves more attention, on a regular basis if possible.

Among the settlement risks arising in the financial system the so-called Herstatt risk is believed to be one of the most significant. We are unaware of any related regular data collection scheme, apart from the above-mentioned Swedish example, or the BIS periodic survey (which is less elaborate, therefore not suitable for the purpose of examining contagion). *Apart from some exceptions, settlement risk has not yet become an integral part of stability analysis, although it is possible that the value added of such an integrated approach could be diminished by the recently introduced CLS system*[3] (which implements a clearing and settlement method under the PvP principle exclusively for FX transactions for the time being) *in some countries.*

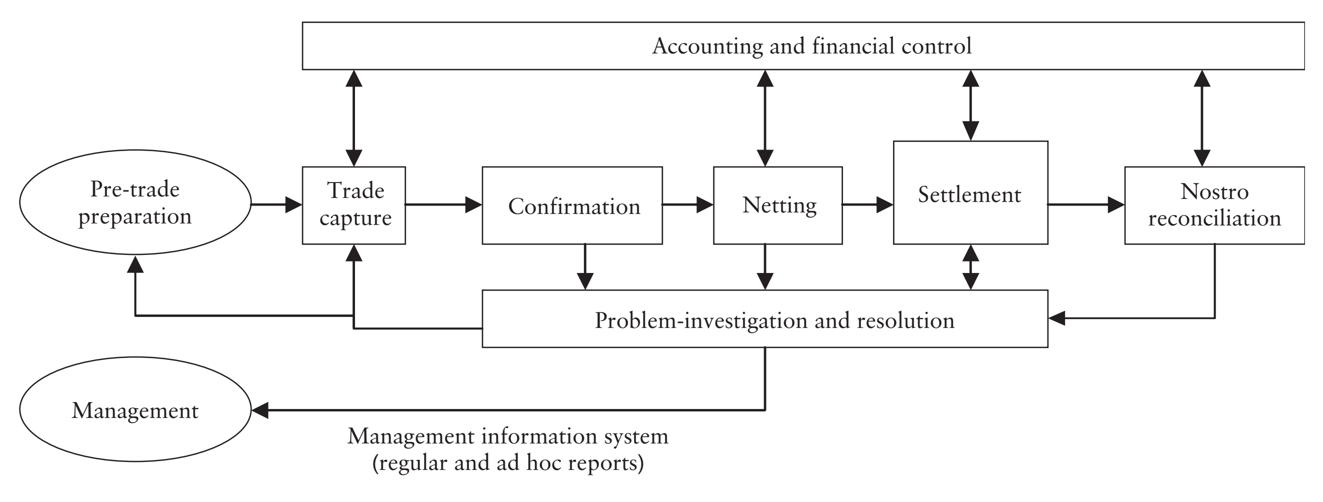
2.2. RISKS RELATING TO FX TRANSACTIONS, FX SETTLEMENT RISK AND ITS CHARACTERISTICS

2.2.1. The lifecycle of the FX transactions and risks arising along the cycle

The lifecycle of an FX transaction begins when pre-trade preparations are made, goes through stages when the deal is actually transacted, and covers the receipt-identification and nostro-reconciliation. Receipt-identification and nostro-reconciliation are intended to identify the transactions actually settled and the ones that remained unsettled (either only delayed or where no settlement can be expected). The FX process flow comprises the following steps (Chart 2):

Chart 2

The FX process flow



Source: FEC, 2004.

1. pre-trade preparation,

2. dealing, trade-capturing and feeding trading data into the internal systems,

3. validation, matching and confirmation of transactions, (automatic) implementation of risk control measures,

4. netting, if agreed,

[3] CLS = Continuous Linked Settlement.

5. *sending the payment instruction in order to transfer the sold currency to the payment systems, or to the correspondent banks regarding the sale of foreign currencies; settlement,*

6. forecasting expected incoming and outgoing cash flows,

7. *receiving notification of the delivery of purchased currency; receipt-identification and nostro-reconciliation.*

During the lifecycle of the FX transaction the counterparties face different risks (Chart 3). Apart from the position (market) and operational risks which are inherent in these types of transactions, credit institutions are also exposed to the following risks:

• renewal risk

• replacement cost risk

• liquidity risk

• settlement (credit) risk.

From the moment the deal is agreed there is a possibility that the partner either falls into delay or defaults on the payment. Credit institutions have to be prepared for this (very unlikely)[4] event, if needed being able to find alternative ways to acquire the financial assets they would have liked to purchase (in this case foreign or domestic currency) by employing other means. Until they maintain possession of the financial assets sold (in this case foreign or domestic currency), they may enter into another trade (of the same type) for the original underlying instrument, running the risk of any shift in the market *(renewal risk)*. This possibility eventuality ceases with the unilateral cancellation deadline of posted payment and settlement instructions.

If a credit institution has already posted its payment and settlement instruction in order to transfer the financial assets payable by itself, then when the payment and settlement instruction becomes irrevocable the credit institution is exposed to *settlement (credit) risk,* meaning that it has settled its obligation. However, there is a possibility that its counterparty will default (or merely fall into delay).

Under the worst case scenario, the credit institution may resort to sell other (similar or different) financial assets from its balance sheet within the framework of various transactions, to obtain the liquidity missing due to the unsettled trades. Nevertheless, it remains exposed to market risks *(replacement cost risk)*. The viability of this path depends on the liquid assets in the credit institution's balance sheet. If the supply of such assets is insubstantial or none is found in the bank portfolio, it leads to the situation where the credit institution is unable to meet its payment obligations temporarily or in the long term *(liquidity risk or insolvency)*. If this spills over to the entire financial sector through interbank exposures stemming from other transactions, and if it causes liquidity or solvency problems for other credit institutions as well, it is known as systemic risk.

2.2.2. Characteristics of FX settlement risks

FX settlement risk, similar to other credit risks, may be characterised by its source (counterparty and counterparty's liquidity problems, probability of default), as well as its size (value of the exposure, loss ratio, compensation paid due to delay) and its duration.

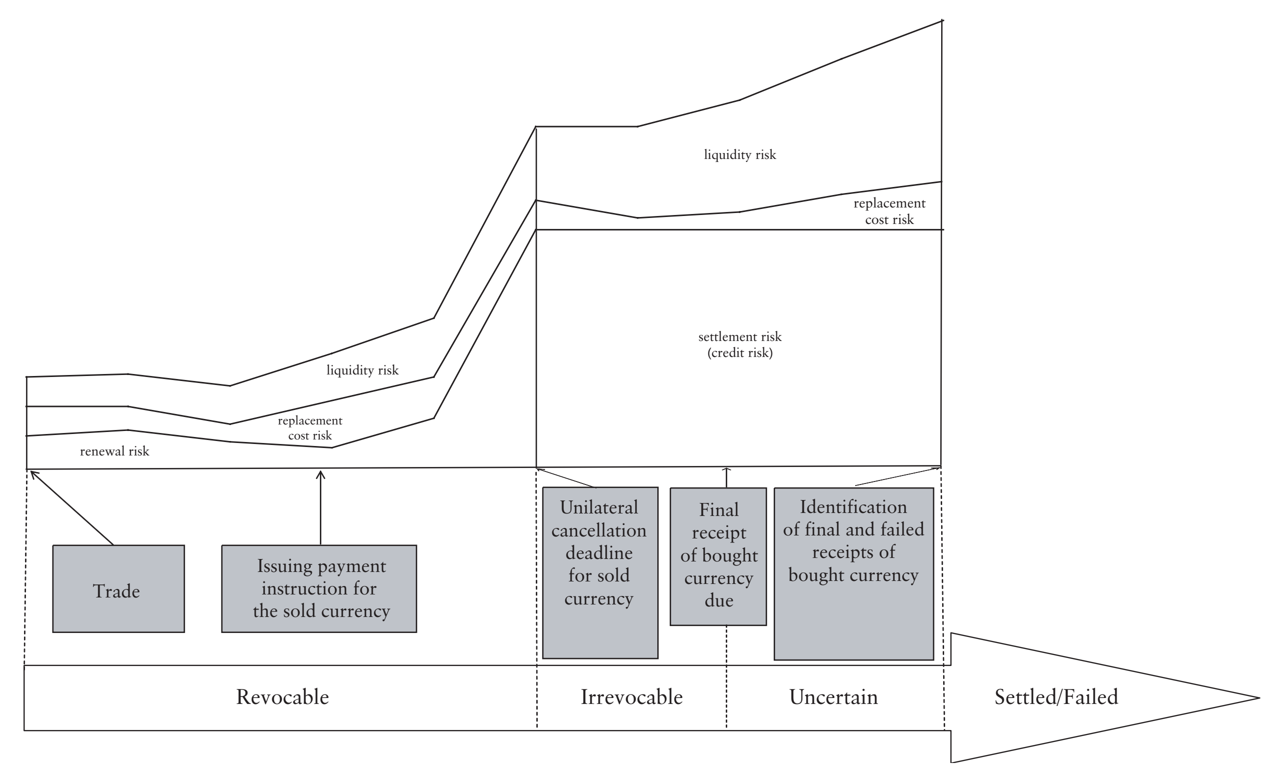
A potential source of FX settlement risk lies in the payment difficulties of the counterparty (liquidity or solvency problem), which could result from the counterparty's own payment difficulties or from those of the correspondent bank (banks) the counterparty uses.[5] An important aspect for assessing the risk is the ability to estimate the *probability of the (combined) crystallisation of these situations* (Chart 5). These problems may lead to delayed, partial or failed payment.

[4] In the earlier MNB survey (MNB, 2001) the authors provided a detailed description of several examples when this occurred. The estimated probability based on past occurrences is relatively low, as these types of events are fairly unusual. As banking supervision has intensified, this probability is presumed to have decreased.

[5] Naturally, in the latter case the client will do all he can to settle his obligations through another correspondent bank; this case refers to the situation when the client falls into delay or when this alternative channel also fails to perform because the client is unable to come up with the funds from other sources.

Chart 3

The lifecycle of an FX transaction and the risks inherent through the lifecycle



Created from charts found in the following documents: BCBS, 2000; BIS, 1996; MNB, 2001; Riksbank, 1998b.

The *size of FX settlement risk exposure* constitutes the nominal value of all outstanding FX transactions, where the payment instruction to transfer the sold currency has already been sent and become irrevocable. However, the receipt-identification and nostro-reconciliation for the purchased currency have not been completed yet, with the value of failed transactions also included. This means irrevocable, uncertain and failed transactions (Chart 3). The realised losses stemming from FX settlement risk exposure are in fact the losses from items which finally remained fully or partially unsettled (taking into consideration the loss ratio, which indicates the percentage of the value of the transaction ultimately left unpaid), plus other expenses due to falling into delay (which could also be claimed subsequently from the partner in question).

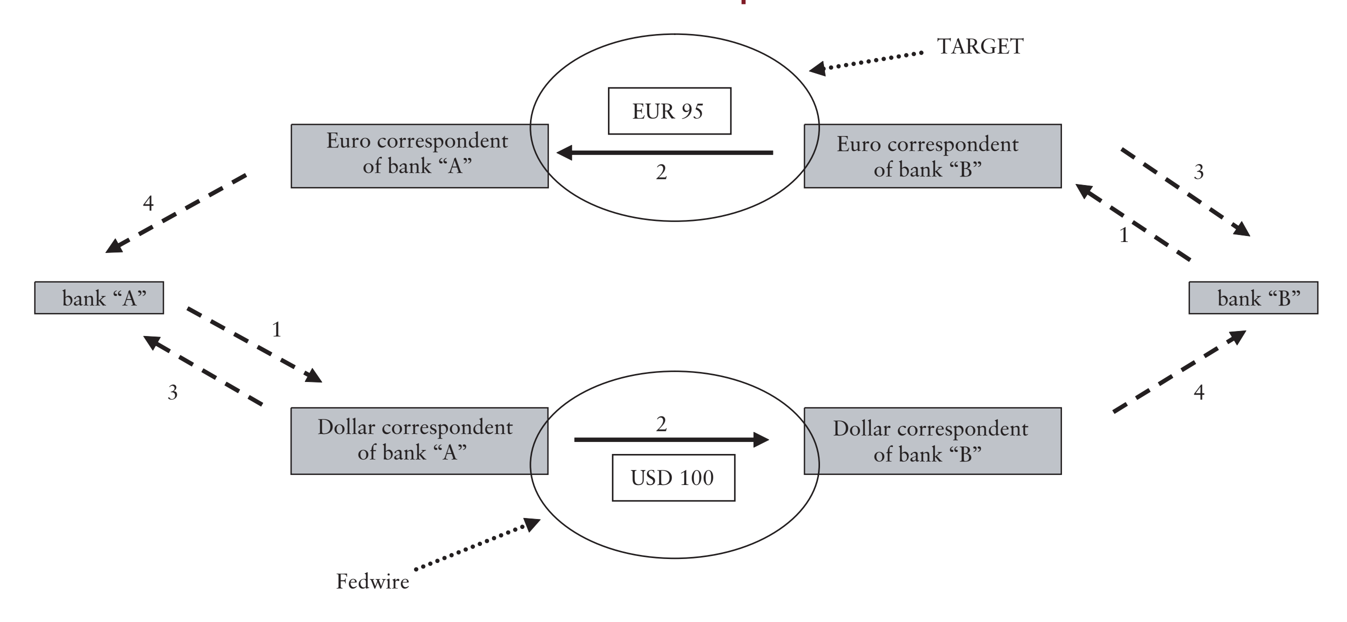
Logically, the definition of the size of exposure also covers the *length (duration) of the risk,* notably that it begins when the payment instruction to transfer the sold currency is sent and becomes irrevocable and it ends when the bank identifies final and failed receipts of purchased currency (receipt-identification and nostro-reconciliation are competed) (BIS, 1996; BIS, 1998; FEC, 2004).[6] International surveys indicate that FX settlement risk is not necessarily intraday exposure, since often it lasts for (1-2) days, and the duration can be even lengthened by weekends and holidays.

[6] Note, however, that this definition of duration of risk follows the approach designed to calculate the length that should be taken into account by the banks' risk management. Obviously, the risk has an ex post (actual or objective) length, which ends at the time shown by the time stamp determined by the final receipt of bought currency due by the correspondent. Nevertheless, the goal of bank risk management and that of the regulatory authority is of a preventive nature, both are aimed to prevent the taking of excess risk. Owing to this, it is important to take into consideration when the bank identifies whether the failure occurred, as it is a random variable until the completion of the receipt-identification. From the standpoint of bank risk management and also of the regulatory authority, these exposures are value at risk until the bank identifies whether the failure occurred, as this is the way to prevent accumulating additional transactions and consequently excess risk in the bank. If the bank or the regulatory authority were to treat the exposure not as value at risk from the expected (most probable) time of crediting its account at the bank's correspondent, the bank would no longer treat it – theoretically speaking – as exposure and could contract additional transactions, even though failure could very well have already occurred, on account of which the risk will exceed the extent deemed reasonable by the bank's internal risk management and by the regulatory authority.

Final payments of the two currencies concerned in FX transactions may be settled in the balance sheets of two different (central or commercial) banks; however, settlement could be effected in one bank's books as well (e.g. a CLS Bank)[7] *under the PvP principle.* If the payments of currencies concerned in an FX transaction are settled independently, the settlement in central bank money and the settlement in commercial bank money can be combined. It may occur that payment for both currencies is settled in central bank money (e.g. in the real time gross settlement systems operated by central banks, hereinafter referred to as 'RTGS') (Chart 4), and it can happen as well that, if both counterparties use the same correspondent bank(s), one (or both) leg(s) will be settled in the balance sheet of the correspondent (commercial) bank they use. However, for larger FX transactions the two payments usually are not linked. Retail customers can have their accounts (both in domestic and foreign currencies) managed by the same bank; hence an FX transaction concluded with the bank is settled between two accounts at the same commercial bank, and usually the settlement follows the Payment after Payment principle (hereinafter 'PaP principle'). What this means is that the bank first checks the client's account for funds and calls it to bookkeeping before crediting the purchased currency to the client's account. So far the linked settlement of two currency legs has been made possible only if the payments are effected in the books of the same bank. This type of clearing and settlement method has been established in two different ways: central banks developed foreign currency RTGS accessible for their own clientele and linked it with their national RTGS (e.g. in Sweden as seen in RIX and E-RIX[8]); or with the help of a CLS Bank (MNB, 2001, Annex 2).

Chart 4

Traditional settlement method of FX transactions via correspondent banks



In the example shown in the chart above bank 'A' sells 100 dollars to bank 'B' for 95 euro. The directions of fund transfer are shown by the bold arrows, while information flow is indicated with the dotted arrows. In example no. 1 the parties instruct their correspondent banks to transfer the funds indicated. In example no. 2 it is carried out in the local RTGS. In example no. 3 the payees are given notice that their payment orders have been carried out. In example no 4 the parties are notified of the transfer received by them.

The chart illustrates the most complex process; it may be less complicated if the same correspondent banks are used or in the case of correspondent banking services provided to one another (e.g. parent bank and subsidiary), and the local RTGS may be left out as well.

The cancellation deadlines and the receipt-identification times, defining the duration of the FX settlement risk, largely depend on the conditions set by the banks and/or the systems that initiate, settle and receive the payments of the sold and purchased currencies on behalf of the counterparties of the FX transactions. These conditions are contingent, on the one hand, upon the bargaining position of the client and the service-provider institutions, and, on the other, on the processing and the degree of automation of the background infrastructure. The level of automation is a double-edged tool, since it supports the fast and

[7] The top settlement bank in CLS.

[8] An RTGS that operates in other than the domestic currency is seldom found around the world. However, they have turned up in, for example, Switzerland, Great Britain, Sweden, Hong Kong and Denmark.

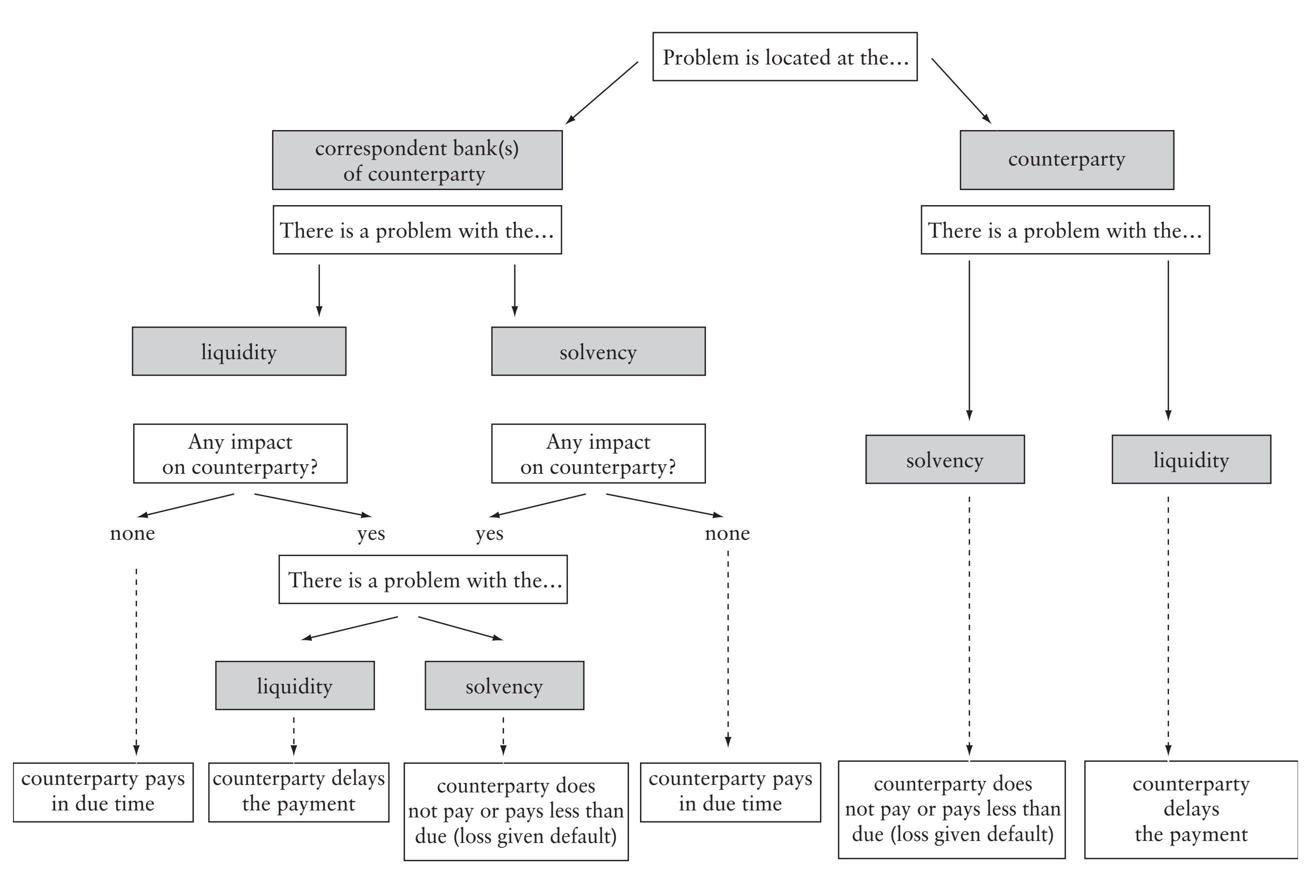
efficient processing of payment instructions, while at the same time the life cycle of a transaction can be interrupted only manually, which is usually not an option in the case of highly automated systems, or it requires complex actions.

Building the FX settlement risk measurement and management methodology on the above-specified characteristics (size of exposure and duration of risk) often calls for re-arranging processing and introducing or strengthening automation on the part of credit institutions, for the purposes of which the following information is needed for each and every transaction (Mundt, 1996; supplemented):

- the counterparty's name, credit rating and other particulars (which could indicate the partner's creditworthiness, and the probability of payment difficulties),
- the date of settlement,
- the currency sold, the quantity sold,
- the currency purchased, the quantity purchased,
- the place of delivery/settlement for the currency sold, if documented and/or guaranteed, the unilateral cancellation deadline, otherwise the submission deadline of the payment instruction (the latter two can be determined from the currency and the place of delivery/settlement),
- the place of delivery/settlement of the purchased currency, the receipt-identification and nostro-reconciliation time (the latter can be determined from the currency and the place of delivery/settlement, and from the timing of internal procedures),

Chart 5

Potential sources of FX settlement risk



- usually, the risk aggregated in a single currency (for example in Hungary in Hungarian forint), that is why the exchange rates between the purchased currencies and the currency used for aggregation are necessary,

- the flag indicating whether settlement of the transaction carries the Herstatt risk,

- the flag indicating that, even if a settlement risk arises, the transaction falls under the scope of a legally enforceable bilateral or multilateral netting agreement, as a result of which the value at risk decreases from gross to netted value.

To incorporate the above information into a single concept and then to the internal systems is difficult, because of which credit institutions tend to simplify things when it comes to measuring the duration of risks and to use the calendar day method (MNB, 2001, Annex 1[9]).

2.3. THE IMPACT OF SETTLEMENT RISK ON FINANCIAL STABILITY

The domestic FX turnover in Hungary (Box 2) grew significantly after widening the fluctuation band of the exchange rate and deregulating the foreign exchange market. This also means that the majority of settlement risk situations arising in the Hungarian financial sector presumably originate from FX transactions.[10]

Box 2: Definitions

Domestic turnover means the foreign exchange transactions where at least one of the counterparties is resident (credit institution or other non-bank participant).

Offshore turnover is complementary to domestic turnover. Accordingly, it means the transactions where neither of the counterparties is resident.

Forint FX market turnover means the foreign exchange transactions where at least one leg of the transaction is denominated in Hungarian forint.

Non-forint FX market turnover means the foreign exchange transactions where neither leg of the transaction is denominated in Hungarian forint.

The in-depth data regarding the structure of the *domestic foreign exchange market* indicate that certain segments of the market (spot, FX swap, forward and options) register substantial turnover (Chart 6) which is concentrated only on a few market participants. What this means is that the risk exposure can not only be substantial, it is not diversified, leaving a great deal of concentration risk. The information supplied by Hungarian credit institutions indicates that the majority of domestic foreign exchange transactions involve forint as one leg, and frequently euro, American dollar and Swiss franc as the other leg (MNB, 2004; MNB, 2005). Depending on the type of market, either the euro or the American dollar takes precedence. The type of market also determines the counterparties vis-à-vis Hungarian credit institutions (non-residents, resident non-bank clients or resident banks). In addition to domestic foreign exchange turnover, according to the MNB's own estimates, so-called *offshore FX turnover* may be even larger.

Although Hungarian banks are not counterparties in offshore foreign exchange transactions, if the transaction concerns the forint, the settlement of the forint leg could finally end up at forint accounts held at Hungarian banks depending on the chain of (correspondent) banks participating in the settlement process. Even though the MNB is unaware of any transactions delayed (or unsettled) due to liquidity problems, in light of the fact that the *forint transactions of foreigners are probably settled by a few Hungarian small- or medium-sized banks, in addition to the domestic FX transactions, offshore FX transactions could also create a great deal of liquidity risk in the Hungarian banking sector. Beyond the liquidity risk, domestic FX*

[9] Beyond the BIS methodology, the MNB analysis from 2001 provides a detailed description of the three methods suitable for the measurement of FX settlement risks. These three methods are: hourly, calendar day and 24-hour period methods. The hourly method gives the closest approximation of the BIS methodology as it takes into account cancellation deadlines and receipt-identification times. However, it updates 'only' hourly the outstanding exposure positions, therefore, if these deadlines and times are between the round hours, under- or overestimation of exposure may occur for however brief a time. The greatest deviation from the BIS methodology lies in the calendar day method, which calculates the value at risk only for the value date between 0:00 and 24:00 hours, ignoring cancellation deadlines and receipt-identification times altogether. The 24-hour period method applies only cancellation deadlines and calculates with the risk between the cancellation deadline on the actual cancellation day until the cancellation deadline on value day. The previous analysis of MNB (MNB, 2001) gives examples to demonstrate the extent to which the various methods involve under- or overestimating the risk exposure compared with the BIS methodology.

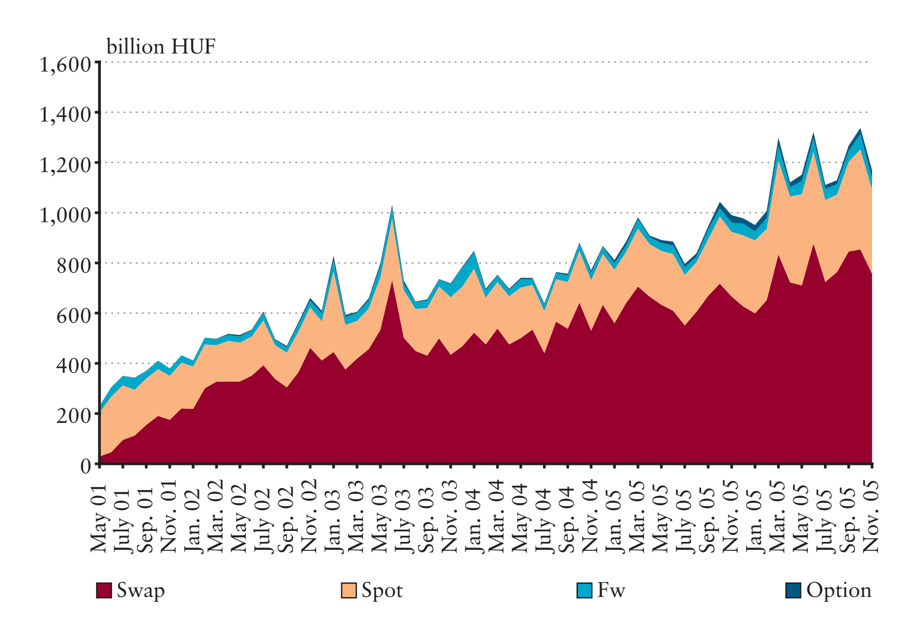
[10] Securities transactions can also carry settlement risk, where the delivery of the security and the transfer of funds are not linked (settlement is done not under the DvP principle). However, this subject is beyond the scope of this paper.

*transactions could bring additional risks (*explained in the previous sections), *as Hungarian banks are involved in the transactions as counterparties, and as such are exposed to Herstatt risk in terms of settlement.*

For the purposes of financial stability the liquidity risk arising in the domestic payment and settlement systems is, of course, an important factor, just like the decisions that may have to be adopted to reduce such risk if deemed necessary in order to ensure the systems' smooth functioning. The objective of this study, however, is limited to the assessment of *FX settlement risk (credit) risk* arising in the Hungarian banking sector (Chart 7). Nevertheless, we should point out that settlement risk relating to forint FX transactions can be borne, apart from Hungarian banks, by their counterparties and by offshore market participants as well. Consequently, the development of infrastructure to eliminate FX settlement risk arising from forint FX transactions could be beneficial not only for Hungarian banks, but also for foreign banks (who may even benefit more in light of internal estimates of offshore FX turnover and their special role in domestic FX transactions).

Chart 6

Value of FX transactions concluded by Hungarian banks*



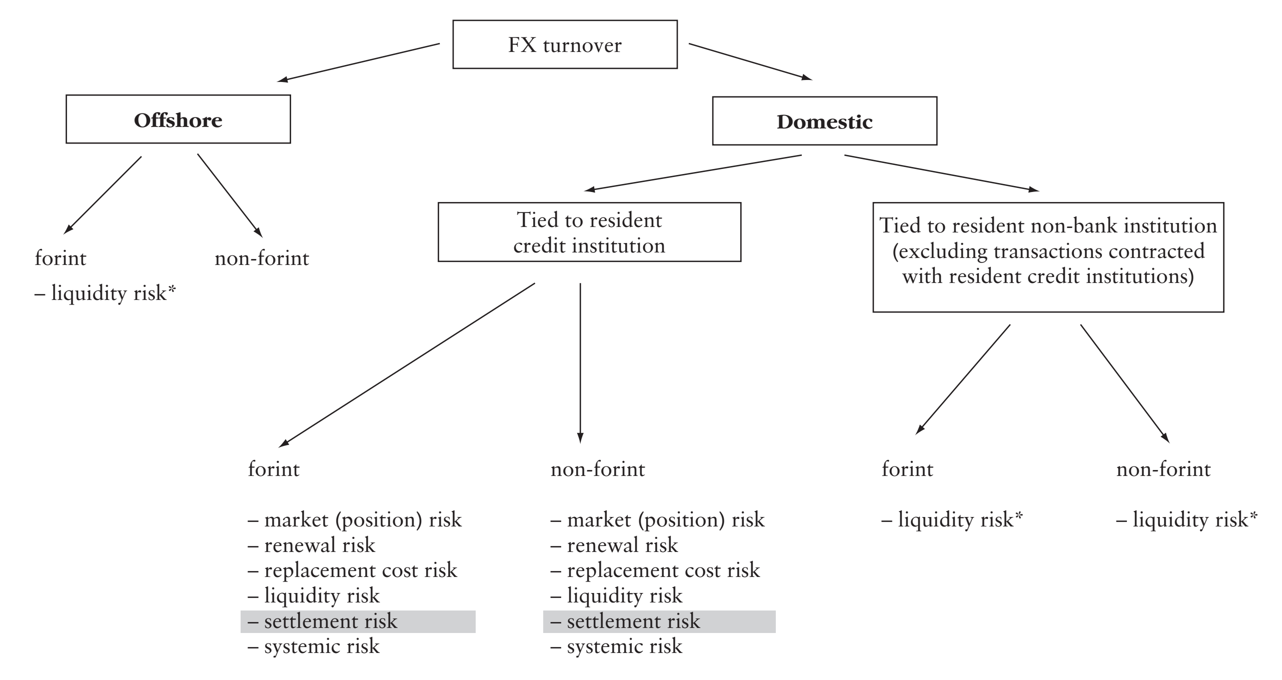
** Note: The published data are based on the daily FX reports of the resident credit institutions concerning foreign exchange transactions (D01). In the case of HUF/foreign currency deals, the transaction value is equal to the value of the HUF side. In the case of foreign currency/foreign currency deals, the calculation is made by using the official exchange rate of the MNB. Transactions among resident credit institutions are not duplicated. The deals are aggregated according to their nominal value. The deals are reported according to the trade-date; in the case of swap deals, only the first leg of the deals is included.*

Even though Chart 6 illustrates the direction of development of FX settlement risks in the Hungarian credit institution sector, it nonetheless fails to offer an exact picture. Firstly, this is because the chart shows data according to trade days, while settlement risk relates more to value (settlement) days (and usually to the previous and following few days). Secondly, of the transactions plotted in the chart only specific deals constitute Herstatt risk for certain, such as FX spot deals and FX swaps (although for the latter including both the spot and the forward legs), while others are conditional. For example, of forward transactions only forwards deliverable, and from options only options exercised lead to settlement.

Although default on FX settlement exposures (meaning that a credit institution that is active in the foreign exchange market becomes insolvent, thus causing significant losses to its counterparties in relation to honouring its payment obligations stemming from FX transactions) is relatively rare (MNB, 2001), the (actual and estimated) turnover data indicate volatile but substantial risk exposure concentrated on relatively few market participants. Hence, it is worth looking deeper into the various characteristics of the special credit risk, thus the FX settlement risk. It is also indicated that, beyond examining the topology of payments of (domestic) payment and settlement systems, the linkages and the contagion could be mapped only by analysing the counterparty and settlement risk of underlying transactions.

Chart 7

Risks in FX transactions from the perspective of Hungarian credit institutions[11]



** If a domestic credit institution participates in the settlement.*

2.4. TOOLS TO REDUCE FX SETTLEMENT RISK

In the previous sections we have provided an overview of the definition and characteristics of FX settlement risk. Naturally, the credit institution sector has also identified this specific credit risk, and it has or had the following tools at its disposal to manage this risk in an appropriate manner:

1. Measuring the size and duration of the FX risk exposure as precisely as possible, keeping bank procedures as simple and inexpensive as possible.

2. As international recommendations (BCBS, 2000) suggest, integrating FX settlement risk into the overall risk management system of the bank. According to these international recommendations, banks should manage FX settlement risk in the same way as credit risks of similar size and with similar duration, and they should also take this into consideration when setting up their limit system.

3. Establishing procedures for handling failed FX transactions, as well as crisis management practices followed in the case of insolvency of any counterparty.

4. Founding a prudential internal monitoring regime.

5. Taking measures to reduce the duration of FX settlement risk, including the renegotiations of submission, cancellation and receipt-notification deadlines with the correspondent banks, in light of the operating hours of each domestic payment system, bargaining for deadlines in order to reduce the duration of risk (e.g. possibility for intraday reconciliation).

6. Reducing the size of FX settlement risk exposure by legally enforceable netting arrangements. Entering into legally enforceable netting agreements with as many counterparties as possible; ensuring that the limit systems are able to take into account the effect of netting.

[11] The Chart illustrates the risks to which Hungarian credit institutions are exposed. Naturally, any counterparty to a foreign exchange contract is exposed to settlement risk if the settlement of the two legs of the transaction is not linked.

7. Reducing the size and duration of FX settlement risk exposure using (an) alternative clearing and settlement method(s) designed to lessen or, in the best case scenario, to eliminate the risk, (e.g. the CLS system, if available).

The use of netting which reduces FX settlement risk (as well as liquidity risk related to settling FX transactions) may be hindered by several factors: one is the legal uncertainty as to whether the arrangement is legally enforceable, plus the lack of sufficient background infrastructure to enhance the integration of netting into bank procedures. There are several types of netting (Blower, 1995) defined according to the number of counterparties participating in netting (bilateral or multilateral), whether it is formal or informal, and legal enforcement. Informal netting means the procedure whereby the back offices agree informally to net the sums to be transferred to one another in an effort to reduce the flow of funds generated by underlying payments. If the netting is not supported by legally binding contracts, it presents considerable risk to the counterparties involved, since in the event of the insolvency of either counterparty the body appointed to manage the assets and liabilities of the insolvent institution (this being Felszámoló Kht. for Hungarian banks) may subsequently demand payment of the gross amounts. Accordingly, it is recommended that *credit institutions employ netting only if secured in a contract, and in accordance with the provisions laid down in that contract, after sufficient legal opinions have been obtained to the effect that in the case of insolvency it can be enforced under the laws of the country where the partner is established.* In certain cases additional protection may stem from so-called *novation,* which means replacing the original contract for gross payment obligations (including any collateral) with a new one for net payment obligations.

In recent years, (national and international) master agreements designed to support certain types of transactions have brought some progress in relation to legal enforceability of netting arrangements.[12] These master agreements often rely on *close-out netting,* which means that in the event of insolvency of either party the claims of the parties are set off against one another after the grace period, and only the debt that remains is liable to be settled.

The efficiency of netting in terms of reducing the flow of funds increases with the number of counterparties participating in the netting process and with the market activity between the counterparties. The infrastructure for *bilateral netting* may be developed individually or jointly, or by an independent third party which identifies and is willing to fulfil the market demand (e.g. the SWIFT NetAccord product, which, in addition to its automatic confirmation facility, is also able to perform netting, on demand, notifying the partner of the results). The infrastructure for *multilateral netting,* however, is generally developed by the stakeholders jointly. In the latter case it occurs rather frequently that an institution responsible for a part of the infrastructure (or the entire infrastructure) enters the deals as the central counterparty and carries out novation.

The use of *alternative clearing and settlement arrangements designed to reduce or eliminate the Herstatt risk* generally requires development or improvement of the domestic and/or the international infrastructures. Although it involves fewer transactions, it includes the situation where a central bank operates a payment and settlement system in a foreign currency for its own customers. The CLS system, as a cross border clearing and settlement engine, can expect a significantly higher volume of transactions. The previous report of the MNB (MNB, 2001) contains a description of the CLS system. It shows that a foreign exchange transaction can be settled in the CLS system if both currencies and the involved counterparties are eligible and capable of using the CLS system.

To the original seven currencies (Australian dollar, Canadian dollar, euro, Japanese yen, Pound Sterling, Swiss franc, American dollar) eight more were added (Danish crown, Norwegian crown, Singapore dollar, Swedish crown, New Zealand dollar, Hong Kong dollar, South African rand, Korean won), paving the way to the settlement of a greater percentage of global FX market activity under the PvP principle. It is important that the introduction of a currency into the CLS system should be preceded by an in-depth (social) cost-benefit analysis (Box 3), taking into account all stakeholders affected (including, for example, participants of the offshore market), plus prospects of joining the euro area, which could have a substantial impact on profit projections. Apparently, from the currencies that joined in the second round none is set to join the euro area, which presumably made the decision easier.

[12] European Master Agreement, ISDA (International Swaps and Derivatives Association) master agreement, IFEMA (International Foreign Exchange Market Agreement) master agreement, ICOM (International Currency Option Market) master agreement, FEOMA (Foreign Exchange and Options Market Agreement) master agreement, etc.

Box 3: Costs and benefits of the introduction of a currency into the CLS system

One of the most important benefits of the CLS system is the PvP (Payment versus Payment) mechanism, which eliminates Herstatt risk related to the settlement of foreign exchange transactions. The expected benefit of applying the PvP principle depends on the size and the duration of the eliminated risk, the probability of default, and of the social costs such a default may result in, for which it is essential to examine the contagion effect (systemic risk). As the denomination of the incoming payment remains uncertain until the final settlement, the settlement method presented by the CLS system does not eliminate other risks arising during the lifecycle of the foreign exchange transaction (renewal, replacement costs, and liquidity risk), and they remain to be managed by the counterparties. One of the further potential benefits the CLS system provides is that the transactions settled via CLS are not charged to the settlement limit, meaning that the credit institution will not pass up on a good FX deal due to the exhaustion of the settlement limits. Another advantage is the usage of netting of mutual claims, which can considerably reduce the liquidity needed for settlement. As a by-product of developments the level of automation in the internal procedures is increasing to keep up with the requirement of efficiency and speed. Putting internal mechanisms toward efficacy may eventually lead to simplified procedures (e.g. confirmation), to lower error rates, and consequently to less compensation payable resulting from such errors (Medeiros, 2006).

Obviously, the described advantages do not come free, as they may involve one-off expenditures (development costs, which may arise directly at the credit institutions or indirectly, in the higher prices paid for use of the relevant infrastructure), or regular expenses. The latter category may include the lost flexibility in timing concerning the strict pay-in and pay-out schedule of the system. Therefore, liquidity risk is reduced upon netting, however, it increases due to the time criticality of CLS-related payments. Moreover, the pre-funded amounts are deposited into a special account, which means that they induce a (temporary) decrease in the available liquidity of the domestic real time gross settlement system. In order to be able to determine the impact at liquidity risk exactly, liquidity stress tests may have to be conducted concerning the individual counterparties and the entire system as well. Where it appears necessary, additional measures will have to be incorporated into the banking system, or into the infrastructure itself to reduce liquidity risk – as was done by the Danish central bank with the extension of the automatic collateralisation agreement (DNB, 2003) – which of course may further increase development costs. In addition, it should be mentioned that the CLS system employs strict membership requirements in order to select members with lower risk profiles, allowing access for others through these selected few only. This not only has the potential of increasing tiering, which may result in hidden credit risk due to internal uncovered credits, it may also increase the concentration of the exposure of indirect participants to correspondent banks with direct access to the CLS system.

Naturally, the present value of the CLS project at the social level cannot be accurately determined solely on the basis of cost and benefit factors; the migration ratio of FX transactions will also have to be estimated. Since the migration of an FX transaction to the CLS system depends on the will of both counterparties, predicting the migration ratio over time is possible only with a high degree of uncertainty – it can be the most difficult part of the cost-benefit analysis. Over-optimistic expectations should be avoided in order to steer clear of mispricing and ex post losses. Furthermore, another aspect to consider is that if the majority of banks exposed to FX settlement risks are owned by non-residents, they do not always view their transactions conducted with their parents risky, in spite of the fact that they are legally independent entities, and following a decision made jointly with the parent, they are unlikely to settle the transactions conducted with the parents via the CLS system.

The admission of a currency into the CLS system requires more than a decision on the part of the potential stakeholders. As is the case for members asking for admission to the CLS system, the eligibility of a currency is also subject to strict conditions. Some of these conditions pertain to infrastructure requirements (e.g. a real-time gross settlement system), while others necessitate appropriate risk management procedures in order to ensure that counterparties can cope with risks potentially arising in the settlement mechanism. The key requirements are related to the liquidity risk and the political and exchange rate risks of the country. (In the payment and settlement system the liquidity risk is low; accordingly, intraday credit facilities are provided and there are at least two credit institutions with minimum A3 credit rating, which are willing and able to finance other members in the currency in question, collateralised by other currencies.)

3. Description of data from the 2006 survey, quality and content

The objective of the 2006 survey was to gain an approximate view of the various dimensions of FX settlement risk arising in the Hungarian banking sector (size, duration, concentration, counterparty risk). Since the 2000 survey, certain structural changes took place in the questionnaire with the aim of obtaining more detailed information. The MNB, on the one hand, requested information concerning more currencies[13] from banks, and, on other, asked the banks surveyed to group the information according to certain criteria, so as to enable the central bank to receive a more accurate picture of the characteristics of FX settlement risk (e.g. the clustering of FX settlement risk exposure according to clearing and settlement methods made it possible to estimate more precisely the actual value at risk). This made the questionnaire somewhat more sophisticated; however, it remained comparable with the results of the 2000 survey with the new details ignored.

The MNB distributed the questionnaire to 15 banks, which proved to be most active based on their domestic FX turnover data reported to the central bank and covered more than 95 per cent of the market in accordance with their transaction data. Thus they were able to serve as a representative sample. Even though it meant less participants relative to the 2000 survey, the MNB decided against a fact finding-exercise in relation to the population (the whole sector) for cost reasons. In the end, 14 credit institutions completed the questionnaire, with some questions left unanswered at times. If the missing information was not obtained later in the interview or by other means, the relevant part of the analysis is based on the results of a smaller sample (this is indicated where applicable). The MNB conducted personal interviews at 13 banks.

3.1. VALUE AT RISK

The notional of the transaction constitutes the size of risk exposure (value at risk). As explained earlier, this means the gross value of expected (to be settled) incoming payments stemming from FX transactions concluded by the bank. This exposure may be mitigated with settlement arrangements fixing conditional settlement (e.g. through the CLS system under the PvP principle, or under the PaP principle used mostly in connection with client accounts), or legally enforceable agreements, which bilaterally or multilaterally reduce the amounts to be settled (e.g. by netting, with which the size of the exposure is the receivables after netting instead of the gross amount). Thus the value at risk could be significantly lower than the gross value of receivables if the banks were to use risk-reducing tools actively (for the detailed definition see Box 4). *As domestic banks provided a breakdown according to the settlement methods and the effect of netting, the value at risk may be calculated taking these into consideration as well.* On the other hand, information about receivables and payables is available only aggregated according to currencies (instead of being broken down according to currency pairs). Therefore, the value at risk cannot be assigned to the duration of the risk which, on the other hand, was determined according to currency pairs.

As far as the size of the risk exposure is concerned, there are certain factors which could lead to under- or overestimation of the value at risk. Firstly, we decided against surveying the whole financial sector for cost reasons, and secondly, one bank did not fill in the questionnaire. Furthermore, we did not conduct the survey with respect to all FX products where settlement, and hence settlement risk can occur, since these are limited to spot deals, swaps and forward transactions.[14] In addition, we compared this data with other information supplied regularly to the central bank relating to the foreign exchange market and found some inconsistencies. Once we managed to identify the (sometimes recurrent) errors and mistakes in the reports, we were able to eliminate most of these discrepancies. However, there still remains an unexplainable minor difference, which indicates that the settled value estimated from D01 reports is sometimes lower and sometimes higher than the value obtained by our survey. *Since after the corrections the signs of individual differences between the two data sets ceased to show any tendency and since the differences were no longer substantial, in our opinion the findings and conclusions of the analysis are robust. All in all, the estimate provides a fairly accurate figure for the real value at risk.*

[13] The questionnaire contained numerous currencies, in connection with which Hungarian banks had nothing or hardly anything to report. Therefore, MNB decided to limit the analyses to the following currencies: CHF, EUR, GBP, HUF, JPY, USD, CZK and PLN. Consequently, relative to the 2000 survey two new currencies, the Czech koruna and the Polish zloty were included.

[14] Accordingly, exercised options and currency interest rate swaps (CIRS) were also left out. However, they are considered relatively minor in the Hungarian banking sector.

Box 4: Definition of specific features of FX settlement risk

In order to receive a complete picture of FX settlement risk we must first form currency pairs according to the bought and sold categories, and determine the size and the actual duration of exposure. Furthermore, the actual duration of exposure can be broken down into two categories, namely, the reference and the excess duration.

1. Size of the FX settlement risk exposure (DvaR):

DVaR =
+ gross FX settlement obligation receivable
– netting effect
– gross FX settlement obligation receivable settled via the CLS
– gross FX settlement obligation receivable settled via PvP or PaP method

Netting effect =
+ gross FX obligation receivable resulting from transactions to be netted
– FX obligation receivable to be settled after netting

Even though CLS also performs multilateral netting, we will not take it into consideration when calculating the netting effect. The netting effect is calculated for those transactions only where bilateral or multilateral netting reduces the amounts to be settled. However, they are still liable to carry settlement risk.

The formulae are based on the values of receivables.

2. Actual (Tb), reference (Tr) and excess (Ta) duration of FX settlement risk exposure:

Tb =
time gap between J and T, if J occurs later than T
otherwise 0, where:

J: means the bank's receipt-identification time for the purchased currency, which may vary for each currency and according to the correspondent bank involved (as the domestic credit institution may use more than one correspondent for settling in a specific currency),
T: means the bank's unilateral cancellation deadline for the payment instruction for the transfer of the sold currency, or if cancellation is not guaranteed (at least on a 'best effort' basis), the deadline for posting the payment instruction. This may vary for each currency and according to the correspondent bank involved (as the domestic credit institution may use more than one correspondent for settling in a specific currency).

Tr =
time gap between Jr and Tr, if Jr occurs later than Tr
otherwise 0, where:

Jr: means the official closing time of the domestic (of the country of origin of the currency purchased) RTGS usually used to settle FX transactions,
Tr: means the official opening time of the domestic (of the country of origin of the currency sold) RTGS usually used to settle FX transactions.

Ta =
Tb–Tr, if Tb>Tr
otherwise 0.

3.2. CONCENTRATION OF FX SETTLEMENT RISK, COUNTERPARTY CREDITWORTHINESS

The settlement data of the various banks provide a clear view regarding which Hungarian banks are most likely to be exposed to FX settlement risk, as well as the concentration of FX market activities and the resulting FX settlement risk on the individual banks of the domestic banking sector. Furthermore, Hungarian banks provided information concerning the concentration or their FX settlement risk among their counterparties, in other words, as to whether this *special credit risk applies only to a smaller group of counterparties*. The external and/or internal ratings of these counterparties can be seen as

important items of information. The questionnaire briefly addresses this issue, as banks have disclosed the number of partners they have rated under the individual credit risk rating categories.

3.3. DURATION OF RISK

The duration of risk we measured using the methodology explained earlier. Therefore, it was essential to have the surveyed banks provide the unilateral cancellation deadlines (preferably documented and guaranteed by the correspondent bank or under the 'best effort' principle), or, in the absence of this, the submission deadline for payment instructions, as well as the receipt-identification times according to currencies. Relying on this information we were able to calculate the *(actual) duration* of FX settlement risk according to currency pairs.

From the 14 banks surveyed, two did not answer the question relating to cancellation deadlines and receipt-identification times, reducing the number of the sample to 12. *The majority of cancellation deadlines are guaranteed on the 'best effort' basis, and not documented.* In the opinion of the banks surveyed, it is very rare that a payment instruction becomes irrevocable immediately when submitted, and they also indicated that they usually succeeded in cancelling payments already posted, when it was necessary. In a large number of cases, banks indicated the same value date and time for submission and unilateral cancellation deadlines. Where the two deadlines were not the same and the banks surveyed indicated that it is very likely that the posted payment instruction could be cancelled on a 'best effort' basis, we calculated with the cancellation deadline. *The fact that cancellation deadline is not documented somewhat increases the possibility of underestimating the duration of risk; however, in the light of the bank interviews this can be treated as insignificant.* As regards the receipt-identification times, banks usually receive their end-of-day statements electronically via SWIFT, which are then reconciled in the morning hours. The reconciliation is automated at all banks (they use systems developed by themselves or others). They do not reconcile with the individual intraday SWIFT notice they receive. Banks do not appear to favour the intraday reconciliation; moreover, some of them even asked the correspondent banks to stop sending the intraday individual SWIFT notice in order to save costs.

Being not guaranteed was not the only reason for uncertainty in connection with the deadlines and times requested, given that the data submitted by the banks were considerably inaccurate.[15] In many cases only the value date was indicated, since the credit institution in question was unable to provide more accurate information according to their contracts or based on common practice. In these cases, we used the *substitution scheme* illustrated in Tables 1 and 2 relying on the opening and closing times of the relevant RTGS.

Table 1

Substitution scheme for cancellation deadlines

		Value date of the reference RTGS opening	
		V-1	**V**
Value date indicated by reporting banks for the cancellation deadline	**V-2**	V-2 12:00	V-2 12:00
	V-1	V-1 RTGS opening	V-1 12:00
	V	V 0:00	V RTGS opening

In the logic of substitutions we strive to use an approach neutral to the duration of risk, meaning if possible to avoid increasing the possibility of either under- or overestimation of it, whereby we did not use any information apart from the opening and closing times of the RTGS which was presumably used for settlement. Hence we did not make any additional assumptions (for example, that the correspondent banks send the statement two hours after closing and it takes another four hours to reconcile this statement).

[15] Uncertainty may have been increased where the surveyed credit institution has had more correspondents for a currency, and consequently numerous cancellation deadlines and receipt-identification times, from which – theoretically – the most unfavourable times should have been indicated from the ones offered by the correspondent banks used the most for FX settlement. This was not specified in this depth in the guidelines. If this information was any help, the deadlines and times were defined more precisely in the personal interviews. Where more than one correspondent bank was used for a currency, it occurred mostly in connection with euro and US dollar. In relation to euro and US dollar we typically encountered two extremes. Some banks used 1 or 2 correspondents as they cut back on the number of relations either on their own initiative or upon the parent bank's instruction, while other domestic credit institutions maintained ties with numerous correspondent banks with a view to good business relations. The banks owned by a foreign parent enjoy, in many cases, the benefits of belonging to a group of banks, manifested mostly in better cost-efficiency.

Table 2

Substitution scheme for receipt-identification times

		Value date of the reference RTGS closing	
		V	**V+1**
Value date indicated by the reporting bank for the receipt-identification time	**V**	V RTGS closing (A)	-
	V+1	V+1 12:00 (F)	V+1 RTGS closing (A)

The substitution scheme, primarily as regards the receipt-identification times, is not necessarily consistent with the above mentioned neutrality criteria; consequently, under- or overestimation may occur, marked ‘A’ and ‘F’ in Table 2. For the purposes of comparison of data from the 2000 and 2006 surveys, we performed the same substitution process for the older data as well.

It is natural that the duration of risk to which Hungarian banks are exposed depends on numerous factors. First of all, on the time difference between the time zones of the countries of the currencies involved in their transactions, and on the operating hours of the payment and settlement systems used for settling the FX transactions (opening and closing time). For the surveyed credit institutions as well as for their correspondents these are exogenous conditions, which are beyond their control in negotiations, and as such they serve as reference. Consequently, from the duration of risk to which Hungarian banks are exposed, the period between the opening of the payment and settlement system where the sale is settled *(reference cancellation deadline)* and the closing of the payment and settlement system where the purchase is settled *(reference receipt-identification time)* is linked to objective circumstances *(reference duration)*. From the available payment and settlement systems of the various countries, we took into account the real-time gross settlement systems, because FX transactions are usually settled via them. For the closing time we applied the interbank cut-off, under the assumption that no intraday statement will be sent and/or reconciled, meaning that statements are sent out and/or reconciled after closing the system.[16] The difference between the actual duration of risk exposure and the reference duration of risk exposure means the *excess duration of risk exposure*.

[16] For each currency the real-time gross settlement system is contained in the Annex.

4. Analysis and assessment of data from the survey

This chapter relies on charts and tables which are essential for the analysis, with all such charts and tables contained in Annex 1. The data below pertain to April 2006.

4.1. SIZE OF THE FX RISK EXPOSURE

The survey suggests that the daily average FX settlement obligation receivable by the surveyed credit institutions was USD 7,786.4 million in April 2006 (Table 3), representing 6.9% of the GDP forecast in 2006 at current prices (for information purposes, the average daily value of transactions settled via VIBER in April 2006 was USD 15,269.61 million). The breakdown according to currencies indicates that the most common currencies purchased include the forint, American dollar, euro and Swiss franc (similar to the currencies sold). The grouping by settlement methods clearly shows that the Hungarian banking sector still prefers to use the traditional settlement arrangements (involving correspondent banks and settlement risk). Bilateral netting is seldom used (four banks to be precise, and only two of them use it for more than two currencies) and only in connection with transactions with corporate clients. Presently, the CLS system has been used in Hungary only by one bank for settlement through the parent bank, for over two years.[17] Settlement of FX transactions concluded with customers without settlement risk is not considered common among Hungarian credit institutions (although a great degree of uncertainty was detected in the personal interviews in connection with this data, therefore, this ratio may be greater than the figure obtained from the survey).

Table 3

Breakdown of gross FX settlement obligations receivable by currency and settlement method (2006)

	Gross settlement obligation payable		Netting effect as percentage of Total	Breakdown of gross settlement obligation payable less netting effect (adjusted settlement obligation payable) by the settlement method			
	million USD	share		Bilateral netting	„On-us" without settlement risk	CLS	Residual
CHF	437.26	5.62%	0.14%	0.36%	1.52%	14.69%	83.43%
CZK	12.06	0.15%	1.09%	1.99%	7.61%	0.00%	90.40%
EUR	951.43	12.22%	1.47%	3.31%	5.45%	5.16%	86.08%
GBP	87.95	1.13%	0.83%	0.98%	0.95%	1.25%	96.82%
JPY	32.67	0.42%	0.11%	0.40%	3.04%	4.19%	92.37%
HUF	3145.94	40.40%	0.51%	0.99%	1.08%	0.00%	97.93%
PLN	48.09	0.62%	0.05%	0.28%	0.93%	0.00%	98.79%
USD	3071.01	39.44%	0.14%	0.18%	0.22%	3.07%	96.53%
Total	7786.40		0.46%	0.91%	1.32%	2.70%	95.07%

Source: Single and regular (D01) reports of 14 Hungarian credit institutions.

As the Hungarian credit institution sector seems to prefer the traditional way of settlement, FX settlement risk amounts to over 95 per cent of the above-specified value (USD 7,423.2 million) in the domestic banking sector (Chart 8). Even though data broken down according to currency pairs is not available, it is apparent that in the *foreign exchange markets the USD/HUF pair must have the largest share* (it is the most favourable combination in the swaps market).

[17] http://www.cls-group.com/news/article.cfm?objectid=C4305435-23EF-42A1-977336EAEEDA4AD3, CLS Bank press release, 1 March 2007, 'CLS third party participants list – 976 now live'.

In order to have a better outlook on the magnitude of FX transactions where forint is involved on either leg, it could be beneficial to calculate how the data on FX settlement forint obligations receivable and payable relate to the credit and debit turnover in VIBER. However, any comparison of the two data requires a great deal of caution for a number of reasons:

• one is that the settlement of the forint leg of an FX transaction, due to internalisation (on-us settlement) does not necessarily lead to a fund transfer in VIBER;

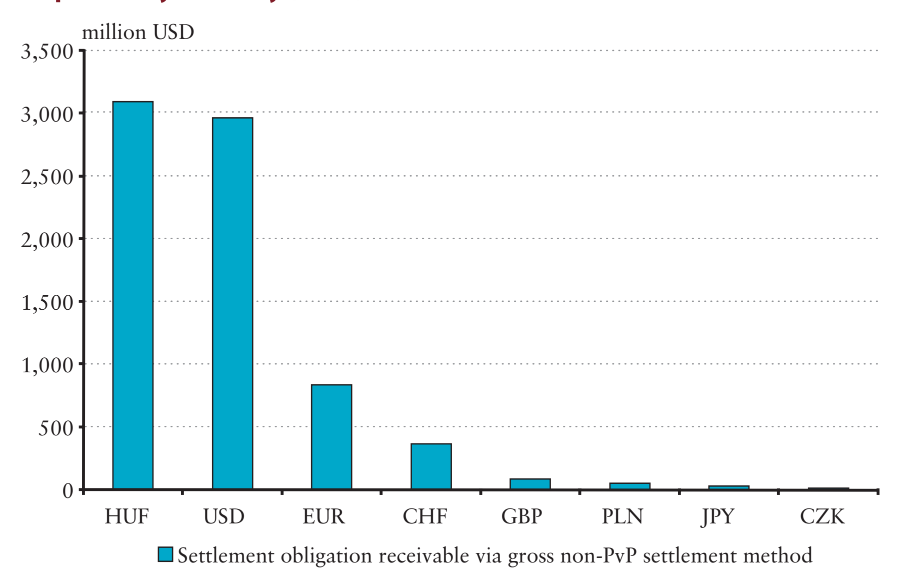
• secondly, in connection with transactions between a domestic bank and a third-party with a forint account at another domestic bank, where the domestic bank ends up in a debit position, the other domestic bank ends up in a credit position, and vice versa;

• thirdly, forint fund transfers in connection with offshore foreign exchange transactions can be also channelled through VIBER, if their settlement is not on-us.

Therefore, the actual volume of transactions settled in VIBER in connection with FX markets is difficult to estimate from the data supplied by banks.

Chart 8

FX settlement risk exposure by currency (2006)



Source: single and regular (D01) reports of 14 Hungarian credit institutions.

The difference between the value indicated here and the residual column in Table 2 is that settlement obligation remaining after netting for those transactions where bilateral or multilateral netting is effected.

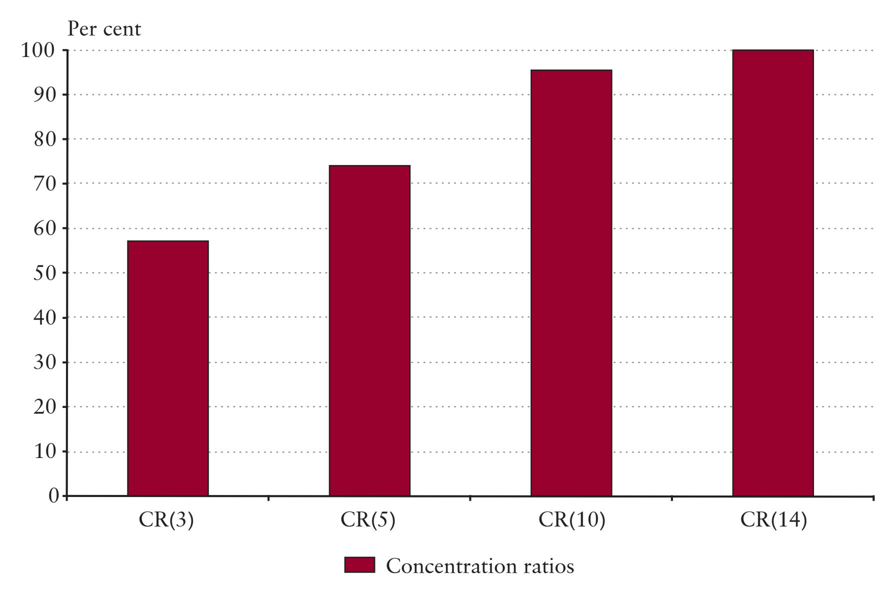
As regards the banks that supplied information in 2006 the daily average FX settlement forint obligation received was USD 3,089 million, representing 24.17 per cent of their average daily VIBER credit turnover (USD 12,780 million) in April. The average daily FX settlement forint obligation paid by these same participants amounted to USD 3,041 million, representing 23.82 per cent of their average daily VIBER debit turnover (USD 12,767 million) in April. This percentage differs considerably among the various banks; the 24.17 per cent figure constitutes the average of percentages ranging between 0.62 and 45.16, while the 23.82 per cent figure represents the average of percentages ranging between 5.26 and 44.33.

4.2. CONCENTRATION OF FX SETTLEMENT RISK, COUNTERPARTY CREDITWORTHINESS

Apart from the aggregate figures of the banking system and currencies, the banking data showed that *the majority of FX settlement risk was concentrated among a group of Hungarian credit institutions containing a small number of banks* (Chart 9), which means that they could demand more attention from the perspective of stability. 75% of the total settlement risk

Chart 9

Concentration ratios calculated from the share of the reporting banks in the FX settlement risk exposure (2006)



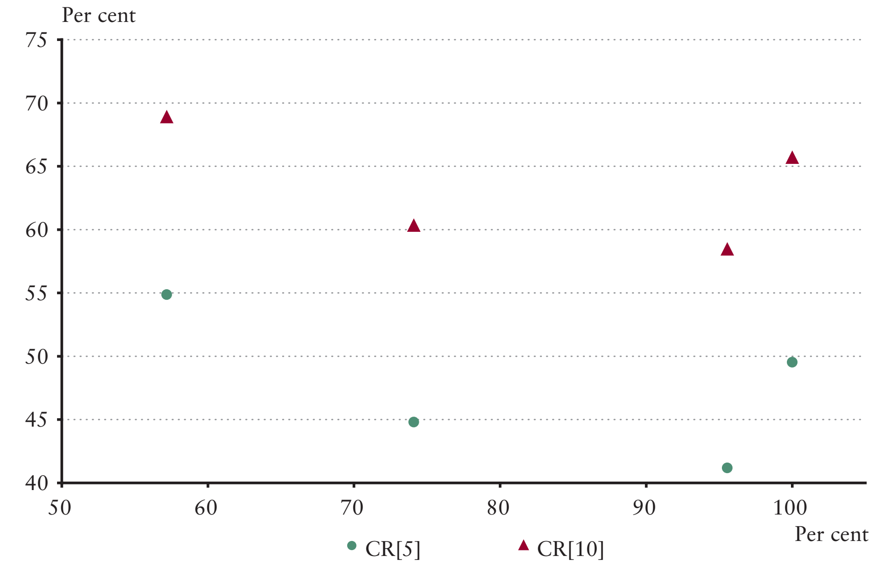
Source: Single and regular (D01) reports of 14 Hungarian credit institutions.

occurring in the domestic banking sector is concentrated among first five reporting banks with the highest share in FX settlement risk exposure.

If the exposure which the banks with the highest shares face is compared to the equity capital, it turns out that the exposure sometimes reached 8-9 times the Tier1 capital and 5-8 times the regulatory capital. Based on the whole sample, the risk exposure amounted to 2.47 times the Tier1 capital on average. However, this indicator differs considerably among the various

Chart 10

Relation between the concentration of FX settlement exposure according to reporting banks (x axis) and the concentration of FX settlement exposure of the relevant reporting banks according to their largest 5 and 10 counterparts (y axis) (2006)



Source: single and regular (D01) reports of 14 Hungarian credit institutions.

The concentration ratio according to the largest 5 and 10 counterparts are calculated as the simple average of the concentration ratios of the relevant (largest 3, 5, 10 and 14) reporting banks.

Table 4

Breakdown of the five largest business partners of the reporting banks by credit rating categories (2006)

Credit rating categories			Classification of five largest business counterparts of banks based on turnover	
Moody's	*S&P*	*Fitch*	*ea.*	*%*
Aaa	AAA	AAA	3	5.56%
Aa1	AA+	AA+	4	7.41%
Aa2	AA	AA	12	22.22%
Aa3	AA-	AA-	10	18.52%
A1	A+	A+	8	14.81%
A2	A	A	6	11.11%
A3	A-	A-	10	18.52%
Baa1	BBB+	BBB+	0	0%
Baa2	BBB	BBB	1	1.85%
Baa3	BBB-	BBB-	0	0%
Ba1	BB+	BB+	0	0%

Source: single and regular (D01) reports of 10 Hungarian credit institutions, with one bank including only its four largest counterparts.

Where the external credit rating (Moody's, S&P or Fitch) was not available, the categories given by the internal credit assessment had to be lined up with the external credit rating categories.

Figures may include duplications.

banks, ranging between 0.22 and 9.95. The same indicator relating to the regulatory capital was 2.25 on average; ranging between 0.19 and 8.97.

The survey not only indicated that the FX settlement risk was concentrated according to the reporting banks bearing it, but also that this credit risk relates to a small number of counterparties (Chart 10). Each point of Chart 10 shows the data of one group of banks. The horizontal (hereinafter: x) axis shows the share of the bank group of the risk exposure (corresponding to the concentration ratios in Chart 9), while the vertical (hereinafter: y) axis indicates the percentage of the FX settlement risk of the banks in question that falls on the banks' first five or ten largest counterparties on average (calculated as the non-weighted average of the figures supplied by the credit institutions surveyed).

The majority of such counterparts are foreign market participants, including many parent banks. Apart from the parent banks, *other foreign market participants* also generate substantial turnover. The significant amount of FX transactions concluded with parent banks leads to *the internalisation of a certain percentage of forint transactions, as well as to specific consequences in relation to risk management practices.* The risk control measures implemented vis-à-vis parent banks are often looser than those employed with regard to others.

The reporting banks also provided information concerning the credit risk rating of their business counterparties, and this indicates that *the five largest counterparties are usually rated between (AA) and (A-)* (Table 4).

In summary, the answers provided in the questionnaires indicate that FX settlement risk is significant in the Hungarian financial sector, and that it often exceeds both the Tier1 and the regulatory capital many times over. Risk is concentrated according to both sides, meaning the domestic banks bearing it and their counterparties (source), where (Hungarian) subsidiaries and their parent banks appear to represent one of the most frequent combinations.

4.3. DURATION OF THE RISK

Following estimation of the risk exposure, the next obvious question concerns how long this exposure usually lasts. In order to obtain a detailed view on this we have looked at the cancellation deadlines and the receipt-identification times for the whole sample as well as individually, and the actual, the reference and the excess duration.

Table 5

Weighted average cancellation deadlines and receipt-identification times relative to reference times (2006)

	Cancellation deadlines			Receipt-identification times		
	Weighted average cancellation deadline (number of hours earlier than reference time)	Reference cancellation deadline		Weighted average receipt-identification time (number of hours later than reference time)	Reference receipt-identification time	
		in local time	in CET		in local time	in CET
JPY	8.51	9.00	1.00	24.46	17.00	9.00
CHF	–7.67	V-1 17.00	V-1 17.00	16.62	16.00	16.00
CZK	–5.30	V-1 16.00	V-1 16.00	16.55	16.00	16.00
EUR	–7.16	7.00	7.00	8.90	18.00	18.00
HUF	0	8.00	8.00	0	16.30	16.30
PLN	9.87	7.30	7.30	14.81	18.00	18.00
GBP	0.25	6.00	7.00	14.99	16.20	17.20
USD	–12.60	V-1 21.00	3.00	4.50	18.30	V+1 0.30
Average	–6.22			3.84		
Average (exl. HUF)	–10.73			6.69		

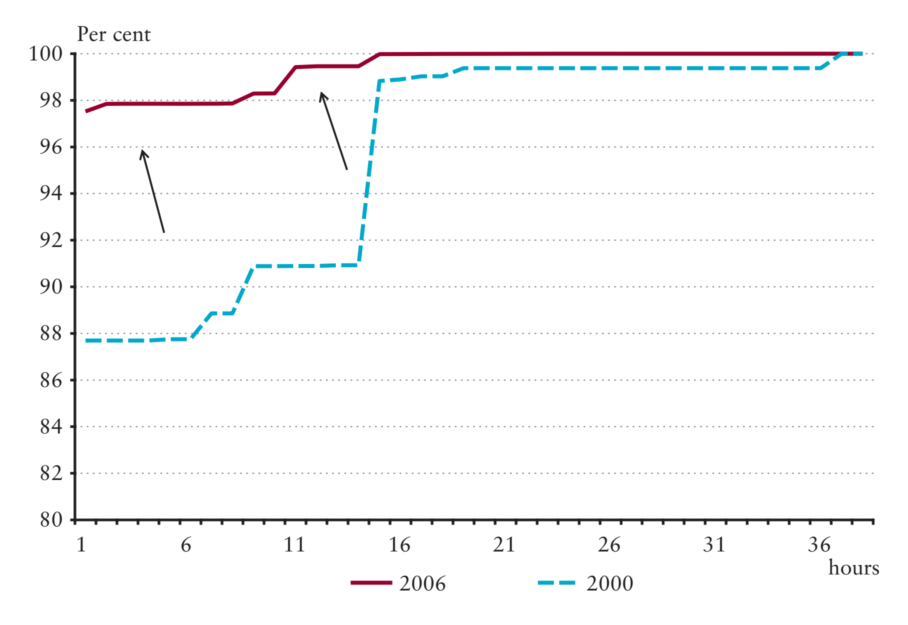
Source: single reports of 12 Hungarian credit institutions.

Currencies are arranged by time zone. The weights used were the value of each bank's settlement flow in the currency concerned (the payables in the case of cancellation and the receivables in the case receipt-identification). The main average is the weighted average of the figures of the various currencies, where the weights are based on the share of the various currencies in the total FX settlement risk exposure.

A negative figure indicates that the reported cancellation deadline is later than the reference cancellation time.

Chart 11

Cumulative distribution function of the difference between the reported and the reference cancellation deadlines (2000, 2006)

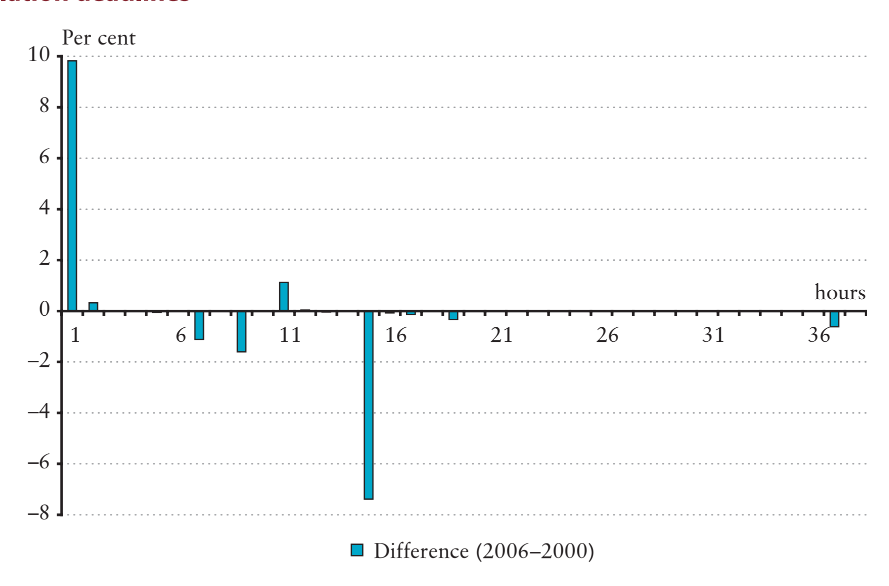


Source: single reports of 11 banks for 6 currencies in the 2000 and 2006 surveys.

Distribution functions are cumulated according to the settlement obligation payable. The x axis indicates the hours by which a reported cancellation deadline precedes the reference cancellation deadline. If negative we indicated it as zero.

Chart 12

Shifts from 2000 to 2006 in the distribution function of the difference between the reported and the reference cancellation deadlines



Source: single reports of 11 banks for 6 currencies in the 2000 and 2006 surveys.
Distribution functions were calculated according to the settlement obligation payable.

According to the data reported, the weighted average cancellation deadline of the banking sector as a whole generally occurs 6.22 hours later than the reference cancellation deadlines (excluding forint transactions, where we automatically applied zero for the differences between the actual and the reference cancellation deadlines and the actual and the reference receipt-identification times alike; this figure is 10.73 hours later than the reference cancellation deadline, Table 5). Accordingly, in connection with a large percentage of the settled transactions the payment instruction to transfer the currency sold is usually still revocable after the opening of the local RTGS. On the other hand, for the receipt-identification the situation is not so positive, as the weighted average receipt-identification time falls 3.84 hours later than the reference receipt identification times (if we exclude forint transactions, it is even worse, notably, 6.69 hours later than the reference receipt-identification times). This, however, can be attributed to scheduling of bank operations, as statements are usually received during the evening hours, which means that nostro reconciliation is carried out only the next day in the morning.

After eliminating the composition effect, comparison of the data from the 2000 and 2006 surveys revealed some *improvement in the average weighted cancellation deadlines* (from -0.94 hour to -6.24 hours) and also the average weighted receipt-identification times (from 9.59 hours to 3.77 hours). *This is also supported by the fact that the cumulative distribution function of the difference between the reported and the reference cancellation deadlines shifted in the 'right direction' (decreasing duration with given reported and reference receipt-identification times)* (Chart 11). Any point of the chart indicates the percentage of payables where the difference between the reported and the reference cancellation deadlines is not greater than the value shown on the x axis.

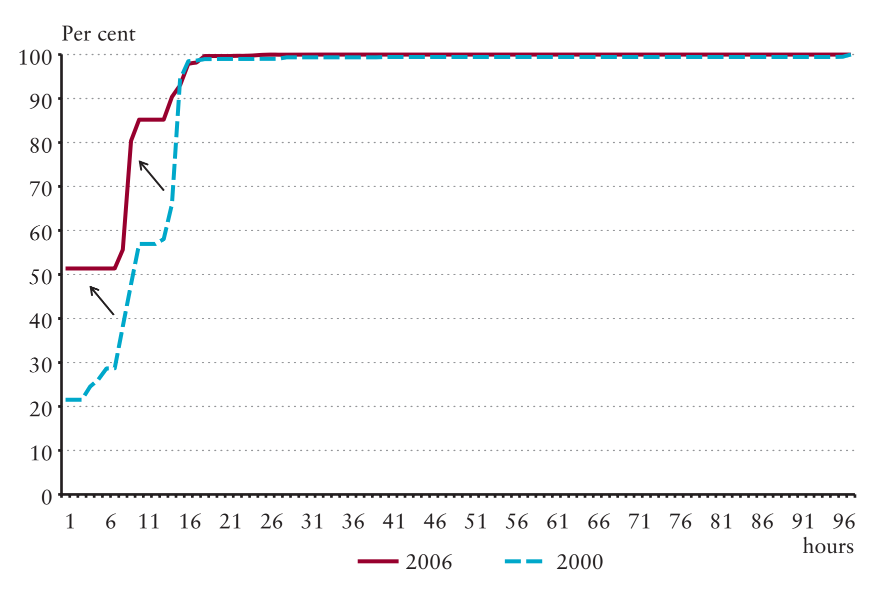
Chart 12 demonstrates the composition of the shift in average weighted cancellation deadlines from 2000 to 2006. It indicates that a massive settlement flow moved from the 15-hour difference toward a 1-hour difference or shorter (negative differences are indicated as zero), although other movements in other directions could also have occurred.

A similar move into *the 'right direction' (decreasing duration with given reported and reference cancellation deadlines) took place as regards the average weighted receipt-identification times* (Chart 13). Any point of the chart indicates the percentage of receivables where the difference between the reported and the reference receipt-identification times is not greater than the value shown on the x axis.

The shift, however, cannot be attributed mostly to a one-way flow, as could be seen in the case of cancellation; this picture seems to be somewhat more complex (Chart 14), manifested in numerous scenarios with many individual shifts probably toward the right direction; however, with some cases toward the other.

Chart 13

Cumulative distribution function of the difference between the reported and the reference receipt-identification times (2000, 2006)

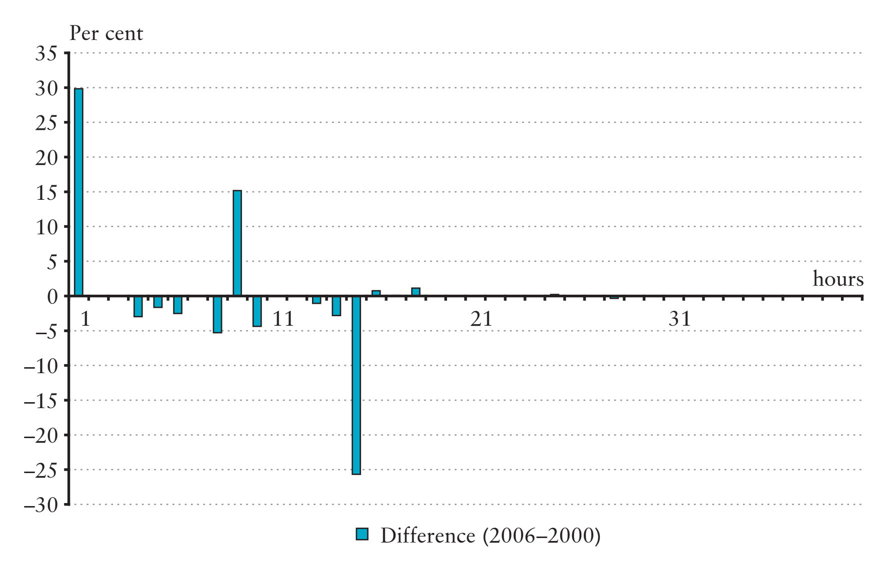


Source: single reports of 11 banks for 6 currencies in the 2000 and 2006 surveys.

Distribution functions are cumulated according to the settlement obligation receivable. The x axis indicates the hours by which a reported receipt-identification time exceeds the reference receipt-identification time.

Chart 14

Shifts from 2000 to 2006 in the distribution function of the difference between the reported and the reference receipt-identification times



Source: single reports of 11 banks for 6 currencies in the 2000 and 2006 surveys.

Distribution functions were calculated according to the settlement obligation receivable.

Owing to the fact that changes in the reference deadlines and times were rare and minor, the shifts in the above-illustrated cumulative distribution functions toward the 'right direction' between 2000 and 2006 can be explained by the following:

- the value of transaction shows a faster growth rate *for those domestic credit institutions* with cancellation deadlines or receipt-identification times which, ceteris paribus, could give better risk duration indicators;

• and this expansion *generally* affected *those currencies* with cancellation deadlines or receipt-identification times which, ceteris paribus, could give better risk duration indicators.

Another possibility could be that the risk duration indicators of the various currencies improved due to the outcome of negotiations with correspondent banks or due to rationalising relations with correspondent banks. However, Hungarian banks reported no such changes.

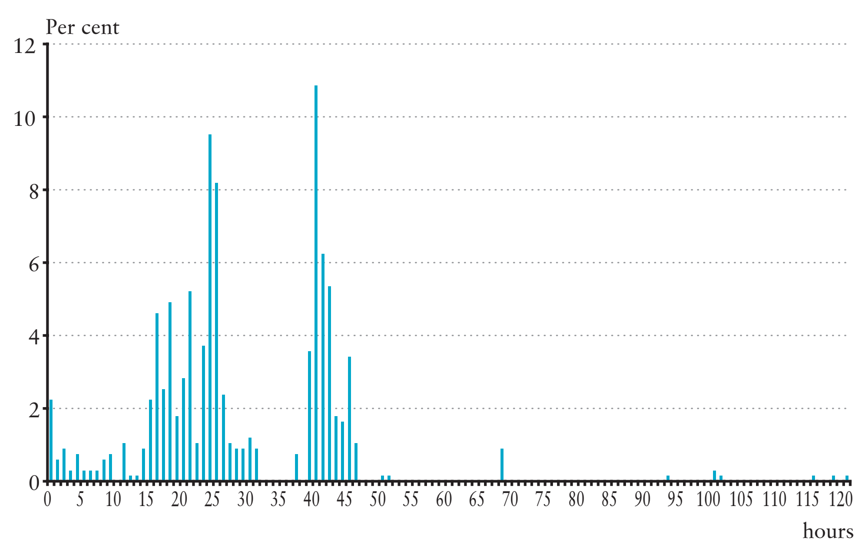
The average improvement of the above-specified cancellation deadlines and receipt-identification times does not automatically signal an improvement in the duration of risk. On the one hand, in some instances these times show some degree of decline (a move 'in the wrong direction'); furthermore, while calculating the duration of risk it is determining how the individual cancellation deadlines and receipt-identification times are combined for a FX transaction. The data received from the 2006 survey suggest that *the actual duration of risk ranges between 0 and 120 hours and that it generally lasts longer than a day; however, it does not exceed two days (Chart 15). Since we did not take into account rest days and holidays, the duration of risk is extended by these days when appropriate.*

Eliminating the composition effect revealed that, while the actual duration in 2000 for the relevant currency pairs ranged between 0 and 117 hours, 29 hours on average (with 19-hour standard deviation), in 2006 the actual duration for the same reporting banks ranged between 0 and 118 hours, 26 on average (with 16-hour standard deviation). *The excess duration,* the component of the actual duration which cannot be explained by the differences in time zones and/or the operational procedures of the local RTGSs, *is typically less than a day* (Chart 16).

Based on the surveys for two different years (2000, 2006) we were able to compute the change in the excess duration broken down according to reporting banks and currency pairs (Chart 17). This showed that, though we could see *that the average weighted cancellation deadlines and the average weighted receipt-identification times moved into the 'right direction' with years, the individual shifts in excess duration are not that uniform, varying within a broad spectrum.* Apparently, there are some currency pairs and bank combinations showing substantial improvements in the excess duration, while in some cases we could see just the opposite. Naturally, this also raises the question of reliability of the information supplied by the banks, as it is rather strange that in connection with individual deadlines and times we see improvements, whereas the difference

Chart 15

Distribution function of the actual durations calculated for each reported bank according to each currency pair (2006)

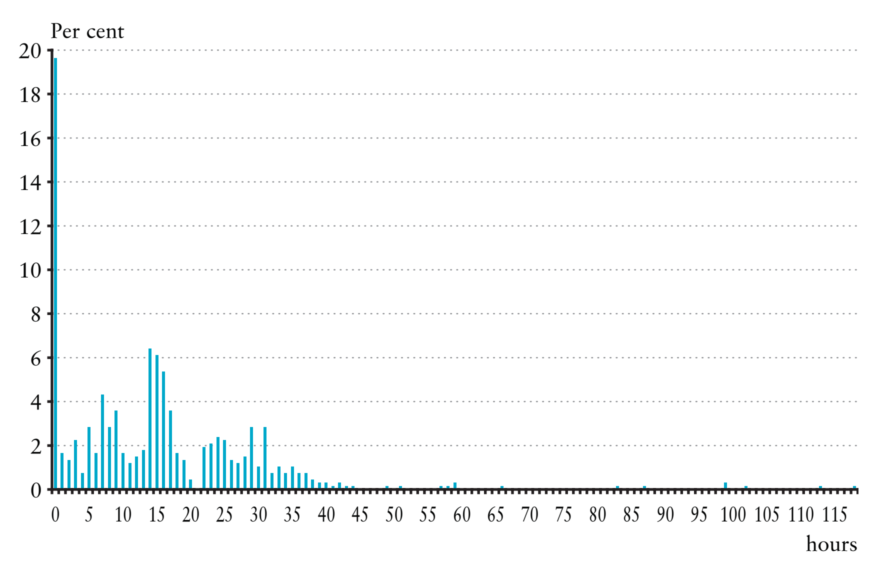


Source: reports provided by 12 banks for 8 different currencies (sample number: 8(8–1)*12=672).*

In the absence of settlement obligations broken down by currency pairs, the observations represent each bank's actual duration in each currency pair, with all observations weighted equally.

Chart 16

Distribution function of the excess durations calculated for each reported bank according to each currency pair (2006)

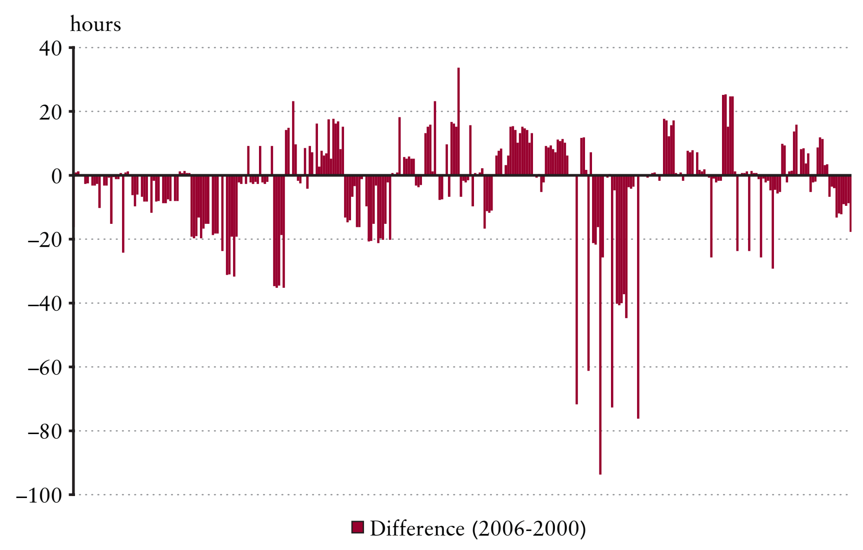


Source: reports provided by 12 banks for 8 different currencies (sample number: 8(8–1)*12=672).*

In the absence of settlement obligations broken down by currency pairs, the observations represent each bank's actual duration in each currency pair, with all observations weighted equally.

Chart 17

Shifts from 2000 to 2006 in the distribution function of the excess duration for each reported bank according to each currency pair



Source: reports provided by 11 banks participating in both the 2000 and the 2006 survey, for 6 different currencies (sample number: 6(6–1)*11=330).*

In the absence of settlement obligations broken down by currency pairs, the observations represent each bank's actual duration in each currency pair, with all observations weighted equally.

Table 6

Actual duration for the selected currency pairs based on the data received from the first five banks ranked according to their share in the FX settlement risk exposure (2006)

Sold currency	Purchased currency	Actual duration of exposure (hours)				Time difference (hours)
		Maximum	Minimum	Average	Standard deviation	
CHF	HUF	24.5	4.5	12.9	10.2	0
HUF	CHF	26	24	24.5	0.7	0
EUR	HUF	3.5	1	1.1	1	0
HUF	EUR	26	24	24.5	0.7	0
USD	HUF	6	0	1.8	2.6	–6
HUF	USD	26	1	20.3	10.8	6
EUR	USD	20	0	14.3	8.1	6
USD	EUR	22	12	16.6	3.8	–6

Source: reports provided by 5 banks.

The time difference reflects the time gap between the time zone of the sold currency and the time zone of the purchased currency (any negative figure indicates an earlier time zone).

calculated based upon these individual deadlines and times is not so definitive, meaning that one could have changed to the benefit and the other to the detriment of the bank (which suggests a rather peculiar situation).[18]

As on the basis of the above data *it is not possible to clearly determine the duration of risk for the Hungarian banks active on the foreign exchange market and therefore carrying a considerable percentage of FX settlement risk.* Therefore, we decided to look at the data of these banks in more detail (Tables 6 and 7).

Table 7

Shifts from 2000 to 2006 in the actual duration for the selected currency pairs based on the data received from the first five banks ranked according to their share in the FX settlement risk exposure (2006)

Sold currency	Purchased currency	Bank No.*				
		1	2	3	4	5
CHF	HUF	–15.5	–9.5	20.5	20.5	3.5
HUF	CHF	0	0.5	–2	7	0
EUR	HUF	–18.5	–6.5	–3.5	–6.5	0.5
HUF	EUR	0	0.5	–2	6	0
USD	HUF	2.5	–7.5	–3.5	–14	6
HUF	USD	0	0.5	–25	5	0
EUR	USD	–21.0	–8.5	–24	–4	0
USD	EUR	0	–15.0	-8	–11	4.5

Source: reports provided by 5 banks.

** Banks were ranked by random selection.*

[18] There was one way to resolve this, namely we measured the cancellation deadlines and the receipt-identification times in proportion to value, while we had no values available for the currency pairs, therefore all observations were weighted equally.

Apparently, *the actual duration relating to the most frequently used currency pairs (USD/HUF and EUR/HUF) is typically lower for these banks, even though – similarly to the outcome of the analysis of the whole sample – the individual figures are not that uniform* (Table 7). According to our observations, where the forint is purchased and the euro or the American dollar is sold, the actual duration for the banks active in the Hungarian FX market is limited to a *few hours.* In contrast, with the reverse situation (the forint is sold, and the euro or the American dollar is purchased), the actual duration is approximately *20 hours,* which can be explained largely by the fact that nostro reconciliation usually takes place in the morning hours and, based on our own assumptions, payment instructions to transfer the forint leg of such FX transactions cannot be cancelled after the opening of VIBER.[19,20]

[19] In connection with the FX transactions where the forint is sold, we applied the VIBER opening time as the final cancellation deadline, which may be considered strict since payments are initiated continuously in VIBER, or it may be considered appropriate as internal transactions, if known, are usually settled at the beginning of the day (debiting the resident bank and crediting, for example, the parent bank). Although the level of automation in domestic back offices is considered fairly high for VIBER, still, from the internal queues payments could be cancelled, manually or otherwise. Therefore, in connection with FX transactions where the forint is sold the actual duration could overestimate the true average. As for the intraday distribution of transactions settled in VIBER, 50 per cent of all interbank and customer payments are settled by 11:30. However, we have no information concerning the pattern under which FX transactions concluded on the previous days are settled in VIBER.

[20] Due to the calculation methodology, the half-hour extension of official operating hours effected by MNB on 2 November 2006 could result in a slight increase in the actual duration relating to FX transactions where the forint is purchased, as the bank will not start the reconciliation until the closing; while the actual duration remained unchanged relating to FX transactions where the forint is sold. With reference to the previous footnote, this still stands, since obviously not all forint payments are initiated at the beginning of the day. Thus, if due to the extended operating hours the payment of the forint leg of an FX transaction, notably, the forint sold by Hungarian banks, is delayed on the average, the actual duration could decrease as well. However, this can be considered insignificant relative to the entire duration.

5. Conclusions of personal interviews

The issues discussed in the personal interviews covered the entire value chain of the FX transactions of the surveyed Hungarian banks. These interviews demonstrated that the procedures for handling FX transactions concluded with business counterparties are highly automated, while transactions with retail customers are generally contracted via the phone (with some banks operating a web-based trading platform) and are processed manually, at least in the early stages of the value chain. As the focus of this study is FX settlement risk, in the following we will primarily address issues relating to risk management.[21]

The interviews suggest that Hungarian banks are well aware of the presence of FX settlement risk and that they use the limit system to keep it under control. The use of the settlement limit – which is designed to constrain FX settlement risk – is common practice and generally is built into an integrated limit system. Most Hungarian credit institutions which are owned by a foreign parent have adopted the parent's methodology and employ the risk management principles defined therein. Hungarian banks have stated that they regard the probability of crystallisation of the FX settlement risk (specifically, when a counterparty becomes insolvent and defaults on FX settlement obligations) as very low or even zero, and that any risk to be of a very short duration. Accordingly, they set their settlement limits in line with these presumptions. The subsidiaries of foreign parent banks frequently use global limit systems, resulting in integrating the local limit systems into that of the bank group. Breaking the limits (even if for technical reasons), any transfer between the limits and increasing the limits usually require authorisation, the authorisation levels being defined according to the degree of limit violation, transfer or increase. Furthermore, we have also learned that six banks (one is legally defendable) apply practically indefinite settlement limits vis-à-vis the parent bank.

FX settlement risk is usually measured according to the calendar day method (the methodology developed by BIS would surely be overly labour and cost intensive).[22] The limit is charged with the nominal (notional) value for the settlement date of the FX transaction on the trade day almost in real time. Before concluding the contract, the trader usually runs a 'test deal' to check if there is any free limit available. Of the 13 banks surveyed, only one bank claimed that the FX settlement limit sometimes holds back trading.

Where the counterparty of an FX transaction fails to settle, based on their past experiences Hungarian banks tend to think of technical errors or temporary liquidity problems. In other words, they anticipate delayed settlement only. The postponement generally lasts 1 or 2 days at most, and the resulting costs of delay can be charged to the 'guilty' counterparties as commonly accepted practice in the financial markets – and they usually pay these charges. In general, in these cases the back office notifies the relevant internal departments (trading and risk management) about the matter to be followed up. As delayed settlement does not usually occur due to other than technical or temporary liquidity problems (such as insolvency) they seemed to be uncertain as to which procedure to follow in those cases. The most common conclusion was that in the absence of all relevant information and with a high level of uncertainty they would most likely take a cautious approach, cut back on trading activities with the counterparty in question, and, in possession of sufficiently reliable information, terminate all trading activities with that counterparty. Similarly to settled trades, both delayed and failed (unsettled) transactions cease to charge the settlement limit automatically. Such transactions are charged again to the limit manually by two banks only. The IT systems of all banks are unable to prevent automatic release of charging to the limit where there is a delay of settlement.

Reports are prepared regularly about any breach, transfer, increase and use of the limits inside the banks for various forums (e.g. for ALCO). If there is a foreign parent bank, these reports are sent to the owner as well.

Use of netting in order to reduce risk is not typical for the Hungarian banking sector. Netting arrangements, usually comprising part of the master agreements, are – theoretically – legally enforceable. However, in the absence of judicial precedence Hungarian credit institutions are reluctant when it comes to using them. Drawing from the interviews, there is

[21] We have employed other information throughout the study where deemed necessary and useful.

[22] Some of the surveyed banks are of the opinion that they are obliged to settle a transaction contracted in any case; therefore, even if they knew the final cancellation deadline, they cannot cancel the payment instruction.

even greater uncertainty surrounding close-out netting. Not only are Hungarian credit institutions uncertain about the credit risks mitigating function of netting, the MNB has also indicated (Póra–Széplaki, 2006) *that master agreements with netting and close-out netting agreements* are not recognised by Hungarian law as a means of credit risk mitigation when calculating regulatory capital requirements. For the time being, Hungarian legislation recognises the concept of offsetting only. Therefore, in connection with netting agreements concluded under Hungarian laws it permits setting off only the overdue and homogenous receivables against one another.

Today, the CLS system is used by one Hungarian bank and only through its parent bank. This facility eliminates FX settlement risk in connection with the transactions settled via the CLS system. From the banks surveyed, only a few would be in favour of introducing the Hungarian forint into the CLS system, the reason being, according to some, that settlement limit efficiently and sufficiently controls this particular risk and the limit system has not hindered trading so far. Furthermore, they would not at all be willing to bear the costs in order to make the CLS system work for the Hungarian forint in their internal systems. *Taking into consideration that FX settlement risk is concentrated only among a few domestic credit institutions, that they conduct the majority of their FX transactions with their parent banks and that these parent banks are not considered risky at all, it is obvious that the majority of the banks surveyed are not inclined to make any investment in order to introduce the Hungarian forint into the CLS system.*

6. Summary

As we found some degree of uncertainty in the data collected in the questionnaire (regarding settlement values and times), it is important to point out that each conclusion of the analysis should be treated with caution because they strongly depend on the quality of the underlying data. Bearing that in mind, one conclusion of the above analysis is that the *size of the FX settlement risk in April 2006 proved significant in the domestic banking sector, far exceeding Tier1 capital (and the regulatory capital) in the cases of many banks.* FX settlement risk *is considerably concentrated according to the domestic banks bearing it.* Furthermore, *counterparty credit risk occurring in some Hungarian banks relates to a small number of counterparties, where parent banks – according to other MNB surveys* (Csávás–Kóczán–Varga, 2006; MNB, 2004; MNB, 2005) *– have a substantial share.* Eliminating the composition effect, for the analysed currency pairs the actual duration did not change significantly. It is generally longer than a day; however, it does not exceed two days. *Looking only at the domestic market participants active on the FX market, data suggest that the actual duration is less than 24 hours. In connection with the most frequently used currency pairs, depending on whether the forint is purchased or sold, the actual duration could be only a few hours, or it could be more, closer to 24 hours.*

In its report in 2000, the MNB provided recommendations based on which only small progress has been made. It turned out during the interviews that the settlement limit is in place at all the surveyed banks. However, the banks applied 'looser' risk management principles when determining such limits. This is due to the fact that Hungarian banks still *consider the FX settlement risk as an exposure outstanding typically within the value date, and to the fact that parent banks have a significant share among the counterparties and nearly half of the reporting banks do not consider their own parent banks as risky.* The assumption that the FX risk exposure lasts less than a day (within the value date) also explains why the risk position is usually measured by the calendar day method (even though the recommendation proposed the hourly method, since it would provide more accurate information on the risk position in real time). The data supplied also indicated that while the assumption concerning FX risk exposure lasting less than a day (within the value date) seems acceptable in terms of the cancellation deadlines (though *the lack of documentation and written guarantees carries some degree of uncertainty),* a similar conclusion cannot be drawn in connection with the receipt-identification and nostro reconciliation. *This inconsistency is typically caused by scheduling the receipt-identification and nostro reconciliation for a specific period of the day (meaning the morning of the subsequent day after the value day).* The banks surveyed do not support continuous receipt-identification and reconciliation based on intraday statements due to the additional costs involved, namely the extra fees charged for intraday statements and the reorganisation required in their back offices.

It derives from the inconsistency between risk management practices and the practical scheduling of nostro reconciliation that the transactions (including failed ones) cease to charge the limit earlier than when the bank can be sure about their settlement. Only two of the surveyed banks charge back the failed transactions to the settlement limit manually, and these banks are not among those with the highest FX turnover. It is obvious that until FX settlement risk is present among the banks (in other words, until they contract FX transactions in their own name and they do not use the PvP principle, or any other FX risk eliminating method to settle such transactions), this problem can be removed or mitigated by the following three measures (starting with the ones considered the least expensive and ending with the one that possibly involves the highest investment):

- charging back delayed and failed transactions to the settlement limit as soon as possible, either manually or automatically, or
- intraday (continuous) receipt-identification and nostro reconciliation, or
- developing and introducing a risk assessment method which is more precise in measuring the duration of the FX settlement risk.

The lack of documentation in correspondent bank contracts appears surprising at first glance. However, this may be the result of the fact that these contracts are concluded at the bank group level, which means that though they are not stored locally (in Hungary), they are still available at the relevant parent banks. If from these contracts the subsidiaries receive the information essential for their daily operations, normal functioning is assured. However, there are many examples to the contrary (e.g.

their share in intraday credit lines or certain deadlines is not known). *Another reason for the lack of documentation is the reciprocal provision of correspondent banking services within the banking group, which has the potential to add a great deal of uncertainty into the daily routine if there are exceptional circumstances and unexpected episodes* (e.g. in connection with a late request for cancellation).

Moreover, in our opinion what is even more problematic than the above issues is that *approximately half the reporting banks do not consider their parent bank as risky from the perspective of Herstatt risk,* since from the reporting credit institutions only one is a branch and for the others this approach is legally wrong. Furthermore, this could increase the negative impact of an (unlikely) event on the domestic banking sector (first of all on the subsidiaries), notably, if the parent bank becomes insolvent. Apart from applying infinite limits, another reason of concern is that major limit increases are usually approved by the parent banks, giving rise to a unique conflict of interest regarding the multiple role of the parent, namely that it carries the liability of risk management within the group, while at the same time functioning as the counterparty of the subsidiary.

The completed questionnaires and personal interviews suggest that non-implementation of the recommendations and the willingness to take substantial settlement risk if compared to the capital is the result of two factors:

• the crystallisation of FX settlement risk is too abstract, as a result of which Hungarian banks do not consider it a real threat;

• according to their applied risk management principles, their parent bank is a risk-free institution.

This may explain the situation whereby Hungarian credit institutions consider the estimated benefits too small compared to the costs in relation to most of the recommendations.

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Annex: Tables and charts containing data and information from the survey of FX settlement risk

The annex contains tables and charts compiled from the data and information supplied by the banks surveyed in the questionnaire and in personal interviews. The main body of the analysis contains only a fragment of these tables and charts; however, reference could be made frequently to component data and other trends which are not illustrated therein. Therefore, we thought it was appropriate to attach as an annex all tables and charts based on the survey data to the main material.

SIZE OF FX SETTLEMENT RISK EXPOSURES

Table 1

Breakdown of gross FX settlement obligations payable by currency and settlement method (2006)

	Gross settlement obligation payable		Netting effect as percentage of Total	Breakdown of gross settlement obligation payable less netting effect (adjusted settlement obligation payable) by the settlement method			
	million USD	share		Bilateral netting	"On-us" without settlement risk	CLS	Residual
CHF	302.26	3.88%	0.20%	0.31%	1.03%	9.18%	89.48%
CZK	12.66	0.16%	1.04%	15.95%	16.20%	0.00%	67.85%
EUR	1009.41	12.94%	1.38%	2.24%	8.05%	5.05%	84.66%
GBP	87.62	1.12%	0.82%	1.64%	2.21%	1.39%	94.75%
JPY	46.02	0.59%	0.07%	0.34%	9.85%	3.42%	86.39%
HUF	3094.36	39.67%	0.52%	0.89%	0.96%	0.00%	98.15%
PLN	46.51	0.60%	0.05%	0.81%	0.87%	0.00%	98.32%
USD	3200.97	41.04%	0.13%	0.50%	0.79%	2.80%	95.91%
Total	7799.82		0.46%	0.91%	1.90%	2.19%	94.99%

Source: Single and regular (D01) reports of 14 Hungarian credit institutions.

Table 2

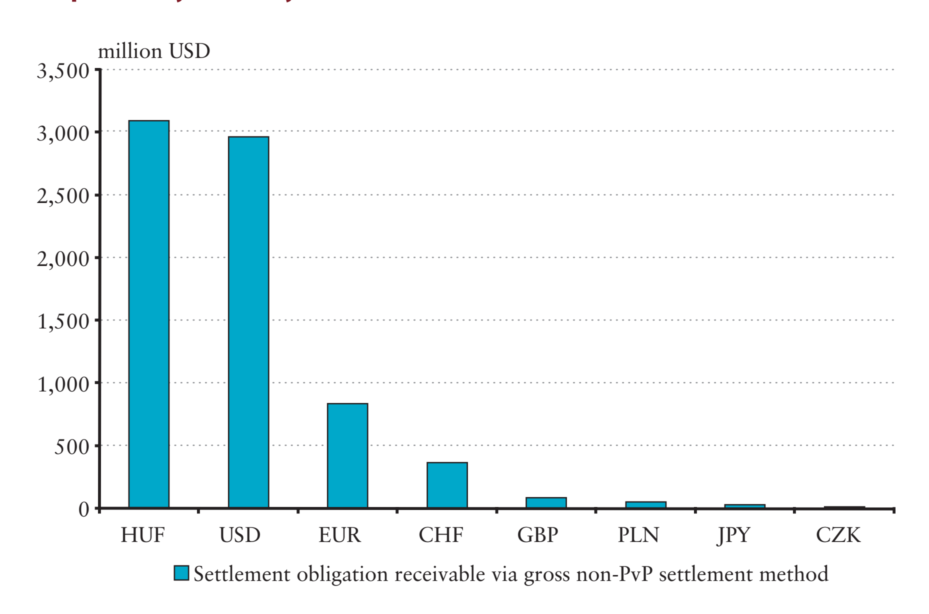
Breakdown of gross FX settlement obligations receivable by currency and settlement method (2006)

	Gross settlement obligation receivable		Netting effect as percentage of Total	Breakdown of gross settlement obligation receivable less netting effect (adjusted settlement obligation receivable) by the settlement method			
	million USD	share		Bilateral netting	"On-us" without settlement risk	CLS	Residual
CHF	437.26	5.62%	0.14%	0.36%	1.52%	14.69%	83.43%
CZK	12.06	0.15%	1.09%	1.99%	7.61%	0.00%	90.40%
EUR	951.43	12.22%	1.47%	3.31%	5.45%	5.16%	86.08%
GBP	87.95	1.13%	0.83%	0.98%	0.95%	1.25%	96.82%
JPY	32.67	0.42%	0.11%	0.40%	3.04%	4.19%	92.37%
HUF	3145.94	40.40%	0.51%	0.99%	1.08%	0.00%	97.93%
PLN	48.09	0.62%	0.05%	0.28%	0.93%	0.00%	98.79%
USD	3071.01	39.44%	0.14%	0.18%	0.22%	3.07%	96.53%
Total	7786.40		0.46%	0.91%	1.32%	2.70%	95.07%

Source: Single and regular (D01) reports of 14 Hungarian credit institutions.

Chart 1

FX settlement risk exposure by currency (2006)



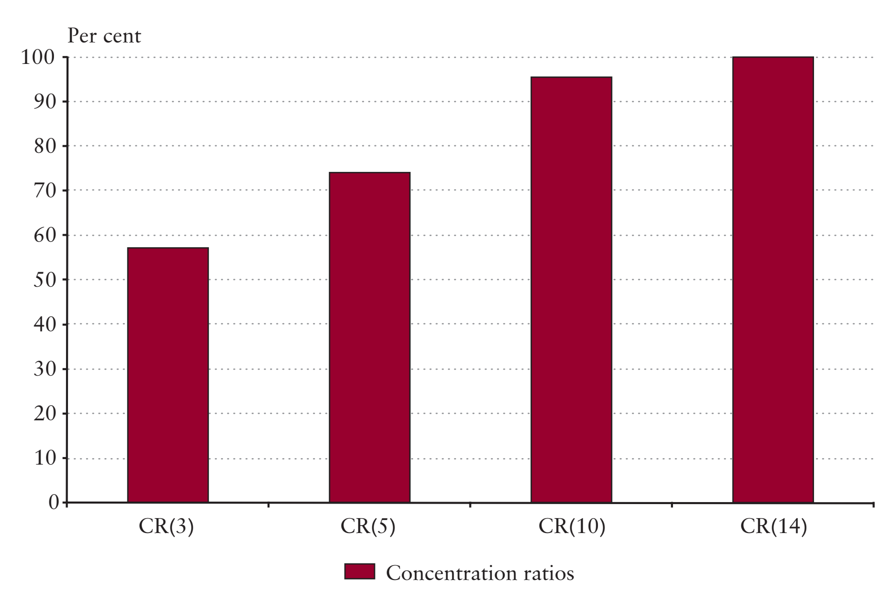
Source: Single and regular (D01) reports of 14 Hungarian credit institutions.

The difference between the value indicated here and the residual column in Table 2 is that settlement obligation remaining after netting for those transactions where bilateral or multilateral netting is effected.

DISTRIBUTION OF FX SETTLEMENT RISK EXPOSURE AMONG HUNGARIAN BANKS: 'TURNOVER CONCENTRATION'

Chart 2

Concentration ratios calculated from the share of the reporting banks in the FX settlement risk exposure (2006)



Source: Single and regular (D01) reports of 14 Hungarian credit institutions.

Table 3

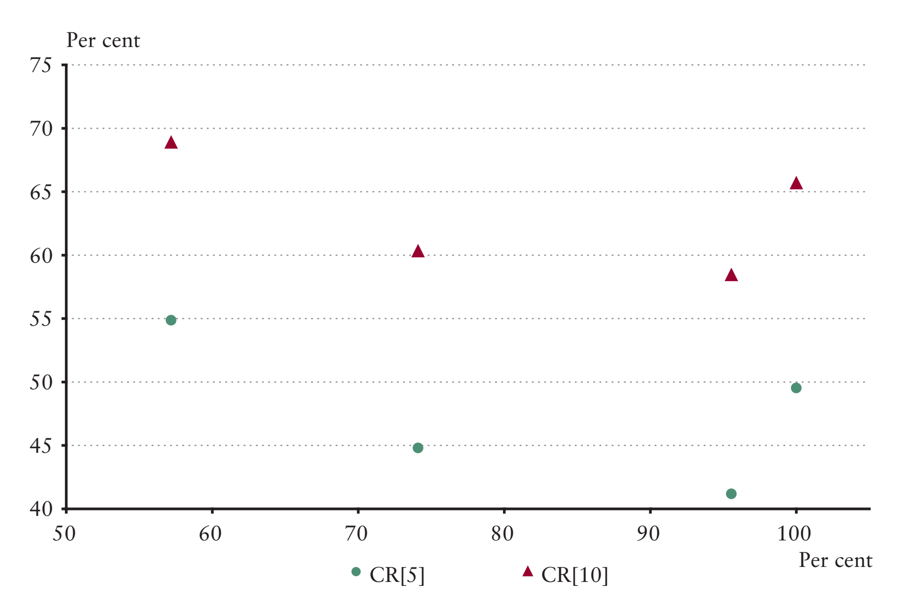
Concentration ratios calculated from the share of the reporting banks in the FX settlement risk exposure

Concentration ratios	
CR(2)	42.86%
CR(3)	57.18%
CR(5)	74.10%
CR(10)	95.56%
CR(14)	100.00%

INFORMATION ON REPORTING BANKS' COUNTERPARTY RISK: CONCENTRATION AND CREDIT STANDING

Chart 3

Relation between the concentration of FX settlement exposure according to reporting banks (x axis) and the concentration of FX settlement exposure of the relevant reporting banks according to their largest 5 and 10 counterparts (y axis) (2006)



Source: Single and regular (D01) reports of 14 Hungarian credit institutions.

The concentration ratio according to the largest 5 and 10 counterparts are calculated as the simple average of the concentration ratios of the relevant (largest 3, 5, 10 and 14) reporting banks.

Table 4

Breakdown of the five largest business partners of the reporting banks by credit rating categories (2006)

Credit rating categories			Classification of five largest business counterparts of banks based on turnover	
Moody's	*S&P*	*Fitch*	*ea.*	*%*
Aaa	AAA	AAA	3	5.56%
Aa1	AA+	AA+	4	7.41%
Aa2	AA	AA	12	22.22%
Aa3	AA-	AA-	10	18.52%
A1	A+	A+	8	14.81%
A2	A	A	6	11.11%
A3	A-	A-	10	18.52%
Baa1	BBB+	BBB+	0	0%
Baa2	BBB	BBB	1	1.85%
Baa3	BBB-	BBB-	0	0%
Ba1	BB+	BB+	0	0%

Source: single and regular (D01) reports of 10 Hungarian credit institutions, with one bank including only its four largest counterparts.

Where the external credit rating (Moody's, S&P or Fitch) was not available, the categories given by the internal credit assessment had to be lined up with the external credit rating categories.

Figures may include duplications.

DURATION OF FX SETTLEMENT RISK EXPOSURE

Table 5

Weighted average cancellation deadlines and receipt-identification times relative to reference times (2006)

	Cancellation deadlines			Receipt-identification times		
	Weighted average cancellation deadline (number of hours earlier than reference time)	Reference cancellation deadline		Weighted average receipt-identification time (number of hours later than reference time)	Reference receipt-identification time	
		in local time	in CET		in local time	in CET
JPY	8.51	9.00	1.00	24.46	17.00	9.00
CHF	–7.67	V-1 17.00	V-1 17.00	16.62	16.00	16.00
CZK	–5.30	V-1 16.00	V-1 16.00	16.55	16.00	16.00
EUR	–7.16	7.00	7.00	8.90	18.00	18.00
HUF	0	8.00	8.00	0	16.30	16.30
PLN	9.87	7.30	7.30	14.81	18.00	18.00
GBP	0.25	6.00	7.00	14.99	16.20	17.20
USD	–12.60	V-1 21.00	3.00	4.50	18.30	V+1 0.30
Average	–6.22			3.84		
Average (exl. HUF)	–10.73			6.69		

Source: single reports of 12 Hungarian credit institutions.

Currencies are arranged by time zone. The weights used were the value of each bank's settlement flow in the currency concerned (the payables in the case of cancellation and the receivables in the case receipt-identification). The main average is the weighted average of the figures of the various currencies, where the weights are based on the share of the various currencies in the total FX settlement risk exposure.

A negative figure indicates that the reported cancellation deadline is later than the reference cancellation time.

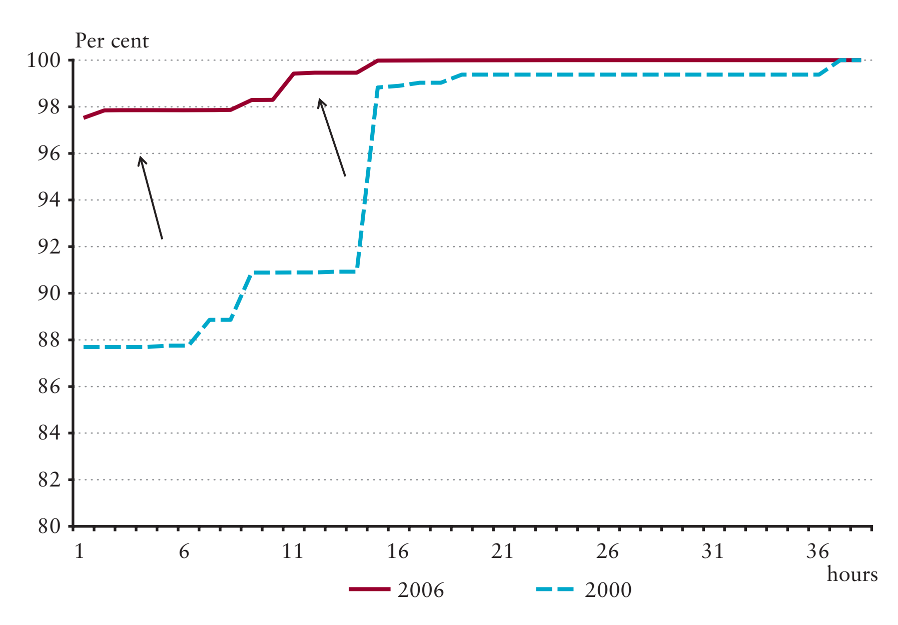
Table 6

Reference domestic RTGS systems

Currency	Reference domestic payment system
JPY	BOJ-NET
CHF	SIC
CZK	CERTIS
EUR	TARGET
HUF	VIBER
PLN	SORBNET
GBP	NewCHAPS
USD	FedWire

Chart 4

Cumulative distribution function of the difference between the reported and the reference cancellation deadlines (2000, 2006)

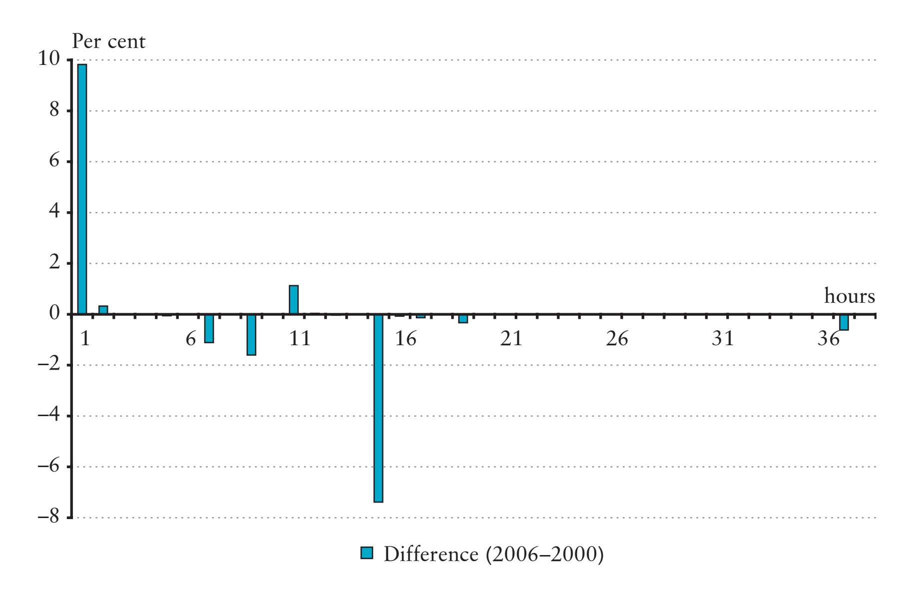


Source: Single reports of 11 banks for 6 currencies in the 2000 and 2006 surveys.

Distribution functions are cumulated according to the settlement obligation payable. The x axis indicates the hours by which a reported cancellation deadline precedes the reference cancellation deadline. If negative we indicated it as zero.

Chart 5

Shifts from 2000 to 2006 in the distribution function of the difference between the reported and the reference cancellation deadlines

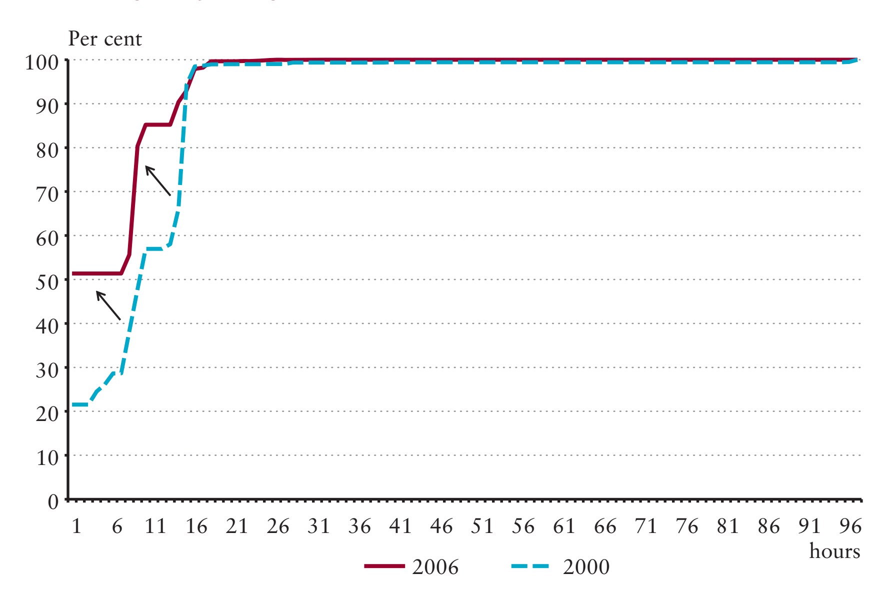


Source: Single reports of 11 banks for 6 currencies in the 2000 and 2006 surveys.

Distribution functions were calculated according to the settlement obligation payable.

Chart 6

Cumulative distribution function of the difference between the reported and the reference receipt-identification times (2000, 2006)

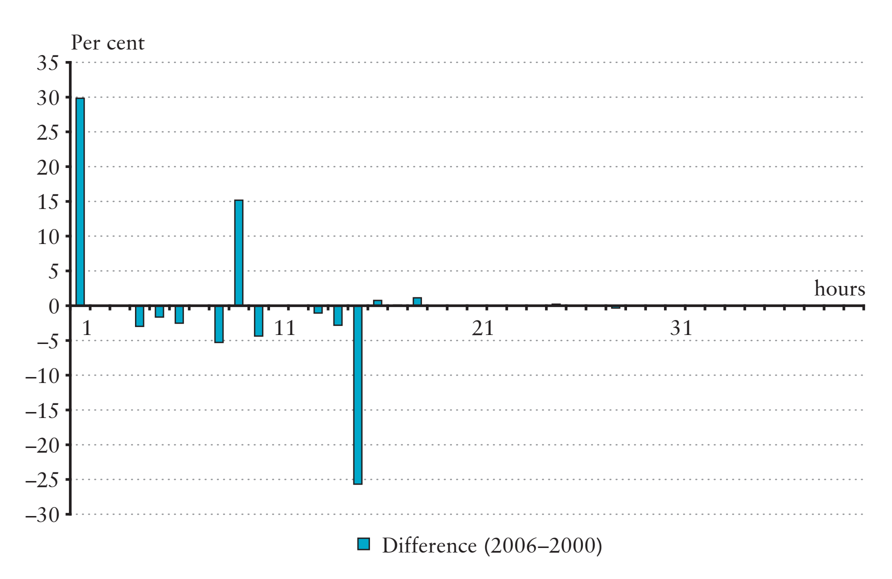


Source: Single reports of 11 banks for 6 currencies in the 2000 and 2006 surveys.

Distribution functions are cumulated according to the settlement obligation receivable. The x axis indicates the hours by which a reported receipt-identification time exceeds the reference receipt-identification time.

Chart 7

Shifts from 2000 to 2006 in the distribution function of the difference between the reported and the reference receipt-identification times

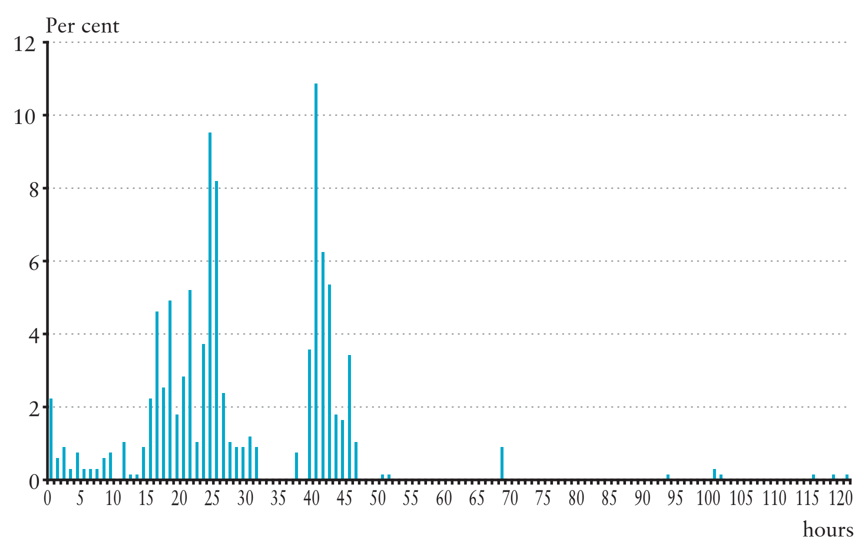


Source: Single reports of 11 banks for 6 currencies in the 2000 and 2006 surveys.

Distribution functions were calculated according to the settlement obligation receivable.

Chart 8

Distribution function of the actual durations calculated for each reported bank according to each currency pair (2006)

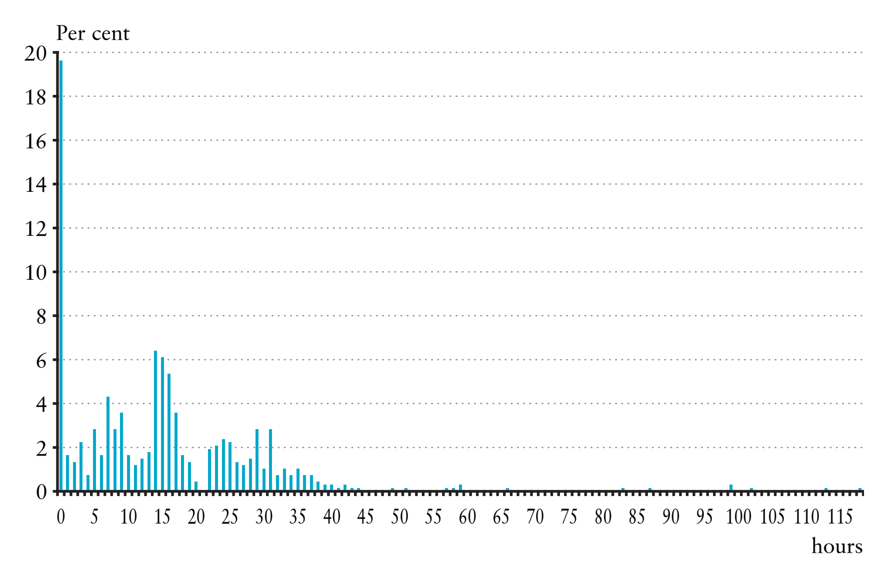


Source: Reports provided by 12 banks for 8 different currencies (sample number: 8(8–1)*12=672).*

In the absence of settlement obligations broken down by currency pairs, the observations represent each bank's actual duration in each currency pair, with all observations weighted equally.

Chart 9

Distribution function of the excess durations calculated for each reported bank according to each currency pair (2006)

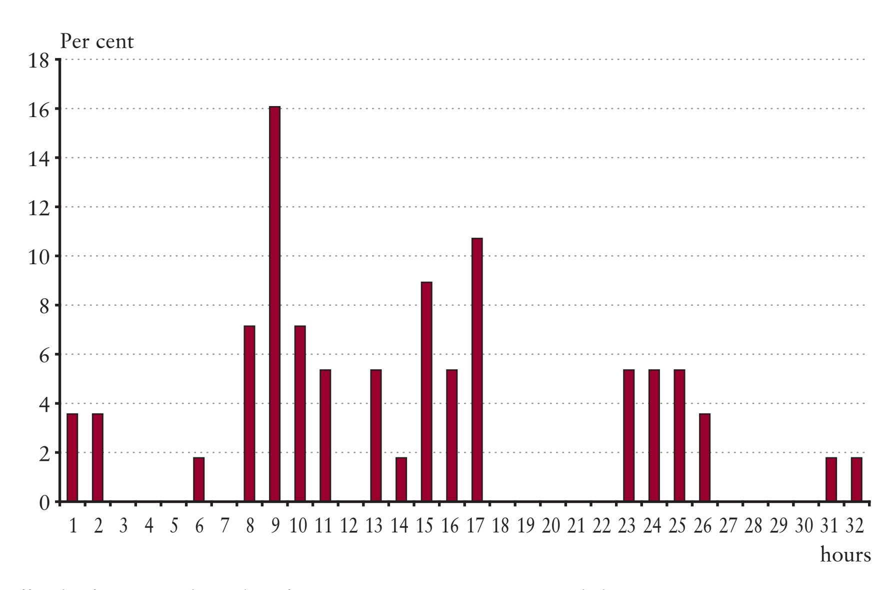


Source: Reports provided by 12 banks for 8 different currencies (sample number: 8(8–1)*12=672).*

In the absence of settlement obligations broken down by currency pairs, the observations represent each bank's actual duration in each currency pair, with all observations weighted equally.

Chart 10

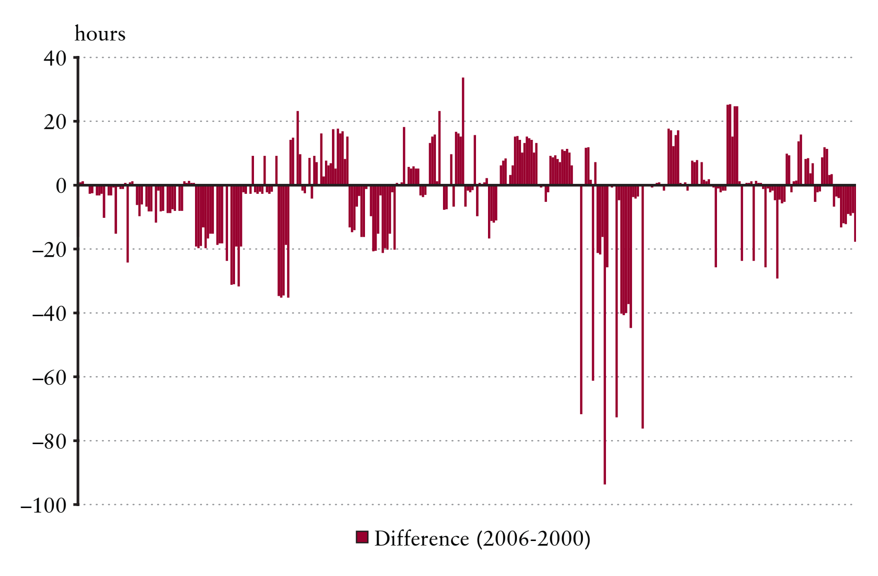
Distribution function of the reference durations calculated for each currency pair (2006)



Source: Data based on official information about the reference RTGS systems' opening and closing (8(8–1)=56).*

Chart 11

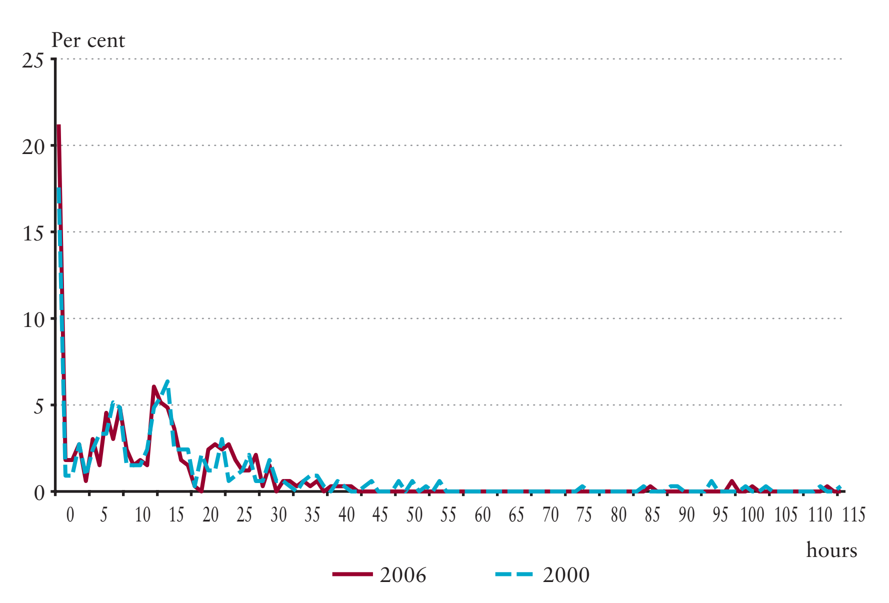
Shifts from 2000 to 2006 in the distribution function of the excess duration for each reported bank according to each currency pair



Source: Reports provided by 11 banks participating in both the 2000 and the 2006 survey, for 6 different currencies (sample number: 6(6-1)*11=330).*
In the absence of settlement obligations broken down by currency pairs, the observations represent each bank's actual duration in each currency pair, with all observations weighted equally.

Chart 12

Distribution function of the excess duration for each reported bank according to each currency pair (2000, 2006)



Source: Reports provided by 11 banks participating in both the 2000 and the 2006 survey, for 6 different currencies (sample number: 6(6-1)*11=330).*
In the absence of settlement obligations broken down by currency pairs, the observations represent each bank's actual duration in each currency pair, with all observations weighted equally.

Table 7

Average actual and reference duration according to currency pairs (2006)

Sell	Buy															
	CHF		CZK		EUR		GBP		JPY		PLN		USD		HUF	
	Actual duration of exposure	Reference duration of exposure	Actual duration of exposure	Reference duration of exposure	Actual duration of exposure	Reference duration of exposure	Actual duration of exposure	Reference duration of exposure	Actual duration of exposure	Reference duration of exposure	Actual duration of exposure	Reference duration of exposure	Actual duration of exposure	Reference duration of exposure	Actual duration of exposure	Reference duration of exposure
CHF	-	-	28.13	23	23.12	25	16.55	24.33	29.62	16	27.47	25	26.07	31.5	15.86	23.5
CZK	30.12	24	-	-	25.66	26	19.09	25.33	32.16	17	30.01	26	28.61	32.5	18.40	24.5
EUR	15.75	9	16.30	9	-	-	4.72	10.33	17.79	2	15.64	11	14.24	17.5	4.03	9.5
GBP	24.59	9	25.13	9	20.12	11	-	-	26.63	2	24.48	11	23.08	17.5	12.87	9.5
JPY	37.99	15	38.54	15	33.53	17	26.96	16.33	-	-	37.88	17	36.48	23.5	26.27	15.5
PLN	30.16	8.5	30.71	8.5	25.70	10.5	19.13	9.83	32.20	1.5	-	-	28.65	17	18.44	9
USD	13.88	13	14.42	13	9.41	15	2.84	14.33	15.92	6	13.77	15	-	-	2.16	13.5
HUF	20.13	8	20.68	8	15.67	10	9.10	9.33	22.17	1	20.02	10	18.62	16.5	-	-

Source: Reports provided by 12 banks for 8 different currencies (sample number: 8(8–1)*12=672).*

Table 8

Actual duration for the selected currency pairs (2006)

Sold currency	Purchased currency	Actual duration of exposure (hours)				Time difference (hours)
		Maximum	Minimum	Average	Standard deviation	
CHF	HUF	26.5	2.5	14.8	10.4	0
HUF	CHF	26	24	24.7	0.7	0
EUR	HUF	24.5	0	6.4	9	0
HUF	EUR	26	0	22.7	7.2	0
USD	HUF	24.5	0	5.4	8.9	–6
HUF	USD	26	1	22.9	6.9	6
EUR	USD	42	0	21.3	11.4	6
USD	EUR	42	0	19.5	11.4	–6

Source: Reports provided by 12 banks.

Table 9

Actual duration for to the selected currency pairs based on the data received from the first five banks ranked according to their share in the FX settlement risk exposure (2006)

Sold currency	Purchased currency	Actual duration of exposure (hours)				Time difference (hours)
		Maximum	Minimum	Average	Standard deviation	
CHF	HUF	24.5	4.5	12.9	10.2	0
HUF	CHF	26	24	24.5	0.7	0
EUR	HUF	3.5	1	1.1	1	0
HUF	EUR	26	24	24.5	0.7	0
USD	HUF	6.0	0	1.8	2.6	–6
HUF	USD	26	1	20.3	10.8	6
EUR	USD	20	0	14.3	8.1	6
USD	EUR	22	12	16.6	3.8	–6

Source: Reports provided by 5 banks.

The time difference reflects the time gap between the time zone of the sold currency and the time zone of the purchased currency (any negative figure indicates an earlier time zone).

Table 10

Shifts from 2000 to 2006 in the actual duration for the selected currency pairs based on the data received from the first five banks ranked according to their share in the FX settlement risk exposure (2006)

Sold currency	Purchased currency	Bank No.*				
		1	2	3	4	5
CHF	HUF	–15.5	–9.5	20.5	20.5	3.5
HUF	CHF	0	0.5	–2	7	0
EUR	HUF	–18.5	–6.5	–3.5	–6.5	0.5
HUF	EUR	0	0.5	–2	6	0
USD	HUF	2.5	–7.5	–3.5	–14	6
HUF	USD	0	0.5	–25	5	0
EUR	USD	–21	–8.5	–24	–4	0
USD	EUR	0	–15	-8	–11	4.5

Source: reports provided by 5 banks.

** Banks were ranked by random selection.*

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